THE AVAILABILITY OF JAPANESE SCIENTIFIC AND TECHNICAL INFORMATION IN THE UNITED STATES

HEARINGS

BEFORE THE

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SCIENCE, RESEARCH AND TECHNOLOGY

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THE AVAILABILITY OF JAPANESE SCIENTIFIC AND TECHNICAL INFORMATION IN THE UNITED STATES

TUESDAY, MARCH 6, 1984

House of Representatives,
Committee on Science and Technology,
Subcommittee on Science, Research and Technology,
Washington, D.C.

The subcommittee met, pursuant to call, at 2:05 p.m., in room 2318, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Members present: Messrs. Walgren, Dymally, Boehlert, Sensenbrenner, Skeen, and Bateman.

Mr. Walgren. Let me call us to order if I may.

Today the Science, Research and Technology Subcommittee will begin two days of hearings to investigate the availability of Japanese scientific and technical information in the United States.

There is a very good reason why we are interested in availing ourselves of the science and technology and technological information that is being generated in Japan. The United States has traditionally been the leader and has traditionally not looked over its shoulder. But Japan now ranks second as a world economic power in the free world and the United States is being forced to face the fact that in many areas we are not No. 1 and that we will not be the preeminent economic power for long if we fail to take account of developments around the world, particularly in a country and culture as sophisticated as Japan.

Japan ranks third in research and development spending in the world and has made the advancement of science and technology a central focus of its national policy, something that clearly has not been the case in the United States.

Japan is making valuable contributions to science and technology and it appears that the United States is certainly not taking advantage of much of the scientific information that is created and is available in the Japanese society.

The collection, analysis, translation, and application of scientific and technical information from all over the world by the Japanese have played a major role in making their economy the second largest in the world and such a success story when we look at the world today.

In contrast, the United States does not have any focused system that Government and industry can use to explore technical developments in other nations. It is my understanding that the National

Technical Information Service has one person in Japan on the U.S. payroll surveying the research that was available in Japanese companies; an ex-executive of Mitsubishi, who certainly was performing a tremendous service for the international economic community when he served our country in that capacity—but clearly one person is the definition of an inadequate effort.

The purpose of these hearings is to raise the level of awareness in this country about Japanese scientific and technical information and to discuss what appropriate actions are needed to create the acquisition, the translation, and the utilization of this information on a level that will meet American needs.

Representatives from industry, academia, and the Government will be asked for their views on what role, if any, the Federal Government should play to increase accessibility to this information; what collection and translation efforts are now being made, and what are the costs and the market in the United States for Japanese science and technology information.

We certainly look forward to creating a record that this committee and others in the Congress can use as a base for their judgments in this area.

Before turning to the first witness, I would like personally to extend both recognition and my appreciation to Mr. Uyehara, who has been very interested in this subject over a number of years, and who has gone out of his way to interest Members of Congress in this subject and contributed substantially to making this a successful exploration on the part of our committee. I think it is a tremendous contribution from a citizen that will stand us in very good stead.

Well, let me turn to the first witness, Justin Bloom, the president of Technology International, Inc., and a former Science Counselor in the U.S. Embassy in Tokyo.

Mr. Bloom, your written statements, and this should be said for all the witnesses, written statements will be made part of the record automatically. And we want to encourage people in their oral statements to just focus on the things that they feel are most important and can be highlighted in the relatively short amount of time that we have for witnesses because we do want to cover a lot of ground in these hearings. So I do want to ask all the witnesses' indulgence about being limited in the time that they use because too much time used by anyone will take away time from somebody else. And I know that we do want to focus on those things which can be highlighted and certainly deserve the direct attention of the oral transcript. And then other thoughts and other points that could be made, please, all of you, know that we would be most interested to receive them, either before or after the hearings, for inclusion in the record, because we want to create a record that will be of the maximum use to those who will use it as a resource for thinking about this area.

Well, with that, let me recognize Mr. Bloom. Welcome to the committee, we are very appreciative of your being here.

STATEMENT OF JUSTIN L. BLOOM, PRESIDENT, TECHNOLOGY INTERNATIONAL, INC., AND FORMER SCIENCE COUNSELOR, U.S. EMBASSY, TOKYO

Mr. BLOOM. Thank you, Mr. Walgren.

I appreciate the opportunity of being able to testify before you and the subcommittee today. The subject is one of my great personal favorites and I will try to give a broad overview of the situation as I see it. My remarks will be very brief and I refer you to my prepared testimony for further details.

I have ambivalent feelings about many facets of the subject of collecting Japanese scientific and technical information. My long experience as a collector indicates, first of all, that there is a large body of information readily available from Japanese sources which is published in English. This source is perhaps the best one for those whose needs are rather general and who do not require details for documentation in scientific treatises, for example. My guess is that this source has gone largely untapped.

While I was posted in Tokyo I began a service for the U.S. Government and the American business community in Japan of publishing lists of sources of technical information available in English in Japan and I found that the interest and the demand for these lists was quite high.

I must admit that I never could make an exhaustive study of just that one part of the subject and my lists were never complete. But I do know that the American Chamber of Commerce in Japan was particularly appreciative of this kind of assistance and used these lists diligently.

Another source of information is the large volume that is generated by various U.S. Government agencies that have representatives in Japan. You have mentioned NTIS and its one representative at Mitsubishi Research Institute but there are some others as well: the Office of Naval Research, for example, stations scientists in Japan who report periodically on various developments in that country, but they do not limit themselves exclusively to Japan.

The U.S. Army Science and Technology Center in Charlottesville, Va., has a subgroup in Japan that collects unclassified scientific and technical information for use by the Army. But somehow that information doesn't seem to ever get very much farther than Charlottesville or perhaps the Pentagon, I don't know. It's a shame; I've seen much of it and it's good information.

Also, often overlooked in discussions of this kind is the fact that the United States and Japan have the most elaborate and intensive bilateral technical relationship at the governmental level of any two countries in the world involving literally thousands of scientists and engineers on each side. They exchange technical information, prepare reports, hold seminars, and conduct joint R&D programs.

The broad consensus of those Americans who are program managers in this bilateral program is that essential equilibrium has been established in the flow of technical information through this channel between the two governments. It didn't start out that way but with the growth of Japanese prowess in science and technology now the amount of information coming to the United States in this particular way is essentially the same in quality and quantity as what goes from the United States to Japan.

Unfortunately, this source of information is not well publicized. And the information obtained from Japan, while extraordinarily useful to those who participate in these programs, is not further disseminated to industry and to universities to any great extent, or at least not to the extent that it should be.

Naturally, the largest and best source of information is the Japanese technical literature itself: the thousands of science and engineering journals, trade newspapers, government reports, and many other kinds of documents which are published in the native language.

By the way, my written remarks are in error. On page 10 I say 1,000 journals, and I meant to say 10,000 technical journals published in Japan. So I would appreciate it if my written testimony is corrected in that one sense.

The Japanese technical literature is no more of uniform quality and importance than the literature of any other nation. So it is imperative that the literature be scanned critically by experts before expensive translation is committed.

Abstracting is the process normally employed to aid this purpose, and it has been interesting to learn that more and more of the Japanese literature is in fact being abstracted into English.

The National Library of Medicine, for example, has performed a pioneering and thorough job in this respect, for the field of biomedical research.

Commercial abstracting and indexing services are paying increasing attention to the Japanese literature, as I am sure you will hear during the course of these hearings.

For the longer term future, I personally think that there would be merit in having effort devoted to machine translation of Japanese and English and vice versa. Technically there is no reason why this can't be done; it is just that it's a horrendous job. It isn't so much the matter of words and their meanings, but the problem of the different syntax between English and Japanese that makes machine translation more complicated than it would be ordinarily.

However, in my mind the only thorough way to comprehend what the science and technology milieu of Japan is really like is to be there to study or perform research at a university or to work in a government or industrial technical organization. Very few Americans have had this opportunity or would have taken advantage of it if it had been offered to them.

There are encouraging signs that this situation is beginning to change. And the rate of change may become great if steps being taken now in both the United States and Japan are fully realized.

Japan, first of all, must provide the opportunity for foreigners to work or study there by removing barriers, real or imaginary, to their interests.

I have had talks recently with very high level representatives of the Japanese industry, government, and academia, which indicate that the problem is fully recognized and that something will be done about it.

On the other hand, I am not yet convinced that there are sufficient numbers of American scientists and engineers who are prepared by cultural disposition and by language training to go in this direction.

Since most Japanese technologists can communicate in English to varying degrees, knowledge of the Japanese language is not imperative but obviously would be of great help.

It remains to be demonstrated that many Americans are willing and, in fact, enthusiastic about making the commitment to spend several years learning Japanese and to then commit themselves to work or study in Japan.

I can't think of a more exciting or interesting place to be abroad but I recognize my own bias in this regard.

Neither am I fully convinced that an adequate demonstration has been made of the demand for a greater supply of technical information from Japan; after all, this is a supply-demand relationship that has to be evaluated.

Historically, or at least in recent history, Americans have not been very adept, in fact, or even interested in absorbing foreign scientific and technical information; and I doubt that they can be force fed.

One of the objectives of this subcommittee should be to determine if a demand exists and to what extent it is not being satisfied by the several different kinds of suppliers.

If all of this is to materialize, something must be done about the negative attitude toward Japan that is often encountered among those who should know better, but who choose to distort the significance of the alliance between the two nations.

If we continue to emphasize the problems and the friction between the United States and Japan, while ignoring the much larger accomplishments that have been achieved, we are not going to encourage Americans to become involved with Japanese science and technology as a career path.

Japan isn't an enemy and it isn't a threat; it's an ally and a friend that has performed extraordinarily well in economic terms and is becoming ever more important in science and technology.

I hope that the competitive challenge offered by Japan will be looked at in this light. If not, we will never be truly well informed of what is going on in that country or in being able to fully exploit the scientific advances made there.

I think, Mr. Chairman, that my remarks have more or less accurately reflected your own views. And if I have accomplished that I will be very happy.

Thank you very much.

[The prepared statement of Mr. Bloom follows:]

Statement for the Record

Justin L. Bloom
President, Technology International, Inc.

Subcommittee on Science, Research, and Technology
Committee on Science and Technology
U.S. House of Representatives

March 6, 1984

A Collector's and User's Views on Japanese Scientific and Technical Information

The Committee on Science and Technology is to be commended for holding hearings on the important subject of the collection and use of Japanese scientific and technical information. These hearings come about ten years too late in terms of optimum effectiveness, but they are welcome nonetheless.

Special credit is due to Professors Eugene Skolnikoff and Richard Samuels of the Massachusetts Institute of Technology for providing an earlier focus on the subject of these hearings through a workshop held at MIT in January 1983 (1). For the first time, to my knowledge, experts on the collection of Japanese scientific and technical information were brought together to exchange and compare their experiences. I was privileged to be a participant and I was impressed by the extent of knowledge displayed by the others present. We concluded that a more determined national effort was needed if full comprehension of the technological status of Japan was to be realized. Among the steps that were agreed to be taken was one that proposed that the Congress be alerted to the current situation and that it be encouraged to hold hearings to further illuminate what could or could not be done to accelerate the flow of technical information from Japan to the U.S. The Congress has responded, recognizing that Japan has become a world leader in the development of industrial and commercial technology and that it is time for the U.S. to insure that technical information commonly available in that country is also available to users here -- just as American technical information has been assiduously absorbed by the Japanese.

I have derived both pride and frustration from being an early enthusiast about Japanese technical progress, going back to my first visit to that country in 1966 and culminating in six years of duty in the front lines as a collector and evaluator while serving as the Science Counselor of the American Embassy in Tokyo. My frustrations came from preparing hundreds of technical reports to the U.S. Government which few read and which did little to inspire the Government to engage in a more intensive and extensive collection function than was possible through my small Embassy office, which had many other responsibilities to discharge. This should not be interpreted to mean that I was the only one engaged in this activity or that the others involved made little impact. To the contrary, there is good evidence to support the contention that in certain ways the flow of technical information from Japan to the U.S. through Government channels has been outstanding in both quality and quantity, and I would like to address this aspect first.

The most obvious device for transmitting information is to station technical people in the country of interest and to give them what can be an exclusive mission to collect and report.

This is being done in Japan by a number of U.S. Government entities:

-- The American Embassy, through its Science and Economic Sections, which include representatives of the Department of Commerce, the National Science Foundation, and the Department of Energy in addition to the Department of State.

-- The Office of Naval Research, which assigns American scientists or engineers to its Tokyo unit and which publishes a quarterly bulletin distributed to some 8000 recipients in the U.S. (ONR Tokyo does not limit its activities to Japan).

-- The National Technical Information Service, through its contractual relationship with Mitsubishi Research Institute and through agreements with Japanese Government organizations.

-- The Science and Technology Center Far East Operations (STCFEO) of the U.S. Army, which collects unclassified information in response to Army needs. These needs are very broad, encompassing almost every technical field.

-- The Foreign Broadcast Information Service, which publishes periodic translations or English-language reproductions of articles which have appeared in the Japanese press through its Japan Report series. This is available to the public through NTIS.

-- The National Library of Medicine of NIH, which funds a thorough program by use of a Japanese contractor of abstracting in English the Japanese biomedical literature, with the abstracts appearing in the MEDLARS periodicals and data banks.

In addition to these Japan-based functions, a major new effort to collect, translate, analyze, and disseminate scientific and technical information originating in Japan has been initiated as a pilot program by the International Trade Administration of the Department of Commerce. It has let a contract to Science Applications, Inc., to perform this task in the specific fields of computers, microelectronics, mechatronics (robotics), and biotechnology. Also, the National Academies of Sciences and Engineering have sent delegations to Japan to explore ways of establishing closer relations through information exchange on computers and microelectronics and on fine ceramics. While these delegations are considered to be non-governmental, they have received financial support from the U.S. Government as do almost all activities of the Academies and their operating arm, the National Research Council.

There is one more governmental channel which requires some elaboration. As the Congress is aware through the annual reports on science, technology, and American diplomacy submitted to the Congress by the President under the provisions of Title V of Public Law 95-426, the United States and Japan maintain an elaborate network of cooperative technical agreements, several of which have been in effect for more than 20 years (2). All of these agreements provided for the exchange of information, the holding of meetings and seminars, the conduct of joint projects, and the exchange of scientists. Through them an immeasurable volume of useful information has flowed from one country to the other. Today the consensus seems to be that equilibrium has been established in most science and engineering sectors, i.e., as much information is obtained by the U.S. from Japan as goes in the opposite direction (3).

In addition to these governmental channels, there are other obvious means by which S & T information is collected for use in the U.S. There are the commercial abstracting and indexing services, previously covering only a small fraction of the more than 10,000 scientific journals published in Japan, but joined recently by a much more thorough on-line data base system offered by Engineering Index at a rather high subscription price not suitable for individual users. Then there are the hundreds of licensing and joint venture agreements among private companies in the two countries for the purpose of effecting technology transfer in both directions, but of course this information is mostly proprietary. U.S. patents awarded to Japanese inventors are another source of information, although some cast doubts on their value. Perhaps the most common vehicle for transferring S & T information is the historical one: personal interchanges between individual scientists and engineers through unofficial channels. Finally, a wealth of information is available through the simple medium of subscribing to English-language newspapers, magazines, and journals published in Japan or by obtaining English-language documents issued in large volume by the Japanese Government. These include technical brochures, White Papers, "visions", and other analytical material. The Japanese Embassy and consulates, JETRO, and similar organizations in the U.S. often have a supply of them. Perusal of these sources quickly leads to the ability to communicate further for the purpose of obtaining additional information.

Well, if all of these vehicles are available, what is the problem? The answer is not immediately apparent and some analysis is required. As I see it, several issues are entailed which are interlocking.

The first part of the problem is psychological in nature. There is a general perception, derived from trade friction perhaps, that Japan is a closed society. "Inscrutable" is a word often used in the past to describe the Japanese. This perception is not generally supported by the experiences of those foreigners who have lived in Japan for a reasonable length of time, but it is true that since the Japanese depend heavily on interpersonal relationships established rather slowly, some time is required before a feeling of mutual trust and confidence leads to free and open intercourse. I liken this situation to the reaction of New Englanders to outsiders, as compared to the reaction of Texans. Even so, one must be careful about drawing sweeping conlusions in such tenuous circumstances. There are always exceptions. Nonetheless, the impression remains that it is difficult to obtain informa- from Japan, and as a consequence Americans don't try very hard.

This is compounded by a more substantial part of the problem, the so-called language barrier. Others will probably discuss this in depth, but in succinct terms we must recognize and accept the fact without complaint that most of the technical literature of Japan is published in the indigenous language and therefore is not directly accessible by the huge majority of Americans. We can assume that this majority is 100% for all practical purposes. On the other hand, as I have just noted, a starting point for gaining access to the Japanese literature *is* available through many English-language publications from Japan. The reasons why they are published include recognition by Japan that its language will never be adopted as an international tongue as English has, the widespread use of English in Japan since it is taught as a second language, and the natural desire by scientists and others to communicate with the outside world. To these reasons can be added a commercial incentive to satisfy foreign needs for information about Japan in those instances where publications are sold, and a political incentive to demonstrate that Japan is not deliberately shutting itself off from the rest of the world. It should not be overlooked that, for whatever reasons, Japan has gone to great expense to make documentation available in English when it has no internal use for this material.

Another part of the problem is the infamous NIH Syndrome. Americans have somewhat of a schizoid attitude toward Japan. Many, including some scientists and engineers, believe that Japanese economic successes have been derivative in that they have resulted almost solely from the introduction of foreign technology, and that the Japanese are neither inventive nor innovative. Those who are in this camp see little need to learn about Japanese science and technology, since Americans are so far ahead. They probably hold the same view of other countries as well. At the same time, some members of this group as well as others look upon Japan with feelings akin to fear, saying that the Japanese are forging ahead of us in advanced technology, e.g., fifth generation computers, and that we must redouble our efforts in scientific research to maintain an absolutely dominant position. I have been deeply disturbed by this contradiction and the emotions which lead to it. How can the Japanese be considered parrots and copiers on one hand and the most awesome challengers to our technological lead on the other? The truth obviously lies somewhere in between. A more enlightened attitude would hold that it behooves the U.S. to be fully aware of technical developments in Japan (and other countries), to accept the challenge, and to avoid reinventing the wheel if others are -- perhaps momentarily -- ahead of us in one field or another. It is in this vein that strengthening our acquisition of Japanese S & T information should be conducted.

Next we should examine further the supply/demand relationship that is assumed to exist. We know that only a relatively small fraction of the supply has been tapped, but what is highly uncertain is the nature and depth of the demand for Japanese S & T information. At the MIT workshop, essentially everyone there was in the business of collecting or supplying information and we were unable to gauge how much of the demand was being satisfied or whether the information was being used effectively. Because of the NIH Syndrome and the general underestimation of the Japanese capability to conduct original research, my intuitive feeling is that the latent demand is not very great in relative terms. This feeling is supported by the lack of strong evidence that commercial suppliers are anxious to increase their capacity to meet that demand. (The recently announced Engineering Index offering may prove to be a significant exception). Professsors Skolnikoff and Samuels have proposed to the National Science Foundation that a study be carried out by MIT which would try to measure quantitatively the demand part of the equation, through interviews and questionnaires.

Something like this needs to be done so that we don't go through another episode of the kind that occurred four decades ago after the end of World War II, when there was a broad consensus that the Soviet Union was going to be our technological nemesis and that all stops should be pulled to translate the Soviet technical literature and to teach every engineer and scientist the Russian language. The launching of Sputnik ten years later seemed to justify this approach, but today the scientific community pays little more attention to the Soviet literature than it does to that of any other country. In other words, a cautious and deliberate approach is required to insure that there is an actual need for more information from Japan beyond that currently being supplied.

For the longer term, I am convinced from my own experience that Japan will become a world power in basic research, as distinguished from applied or industrial research -- where it is already first class. The Japanese have set this as a national goal, believing that because of their economic success they may be cut off from their traditional access to the results of basic research in the West and therefore may have to rely completely on their own creativity. Considering some of the proposals that have been made and actions taken in the U.S. already, their suspicions may prove to be correct, in which case they would be under no moral, legal, or ethical obligation to share their research results with other countries. I prefer to take a more enlightened view along the line that the results of basic research should be exchanged freely among nations, while clearly recognizing that some of these results will be converted into practical applications at some future, ill-determined time. In preparation for Japan's emergence as a leading country in basic research, we should be taking steps to educate a reasonable number of young American scientists and engineers in the Japanese language and to familiarize them with the culture and social environment of that country through work/study programs, research assignments in Japan, or any other means which will produce technologists who are committed to and appreciative of the unique Japanese technical milieu. This approach will be slow and, in our frame of reference, expensive. I can give you a reasonably good analogy: In the Department of State, Japanese language training is considered one of the two or three most difficult language courses offered. It consists of 44 weeks of full-time instruction at the Foreign Service Institute in Washington, followed by a year of total immersion at FSI's branch in Yokohama. The student is then ready to be turned loose at the Embassy or at a consulate in Japan, where he or she embarks on a professional lifetime, so to speak, of learning more Japanese through on-the-job training while carrying out official duties. There must be a strong desire on the part of the student to devote so much of his or her career to the language. The sponsor wants to see a maximum return on investment through several subsequent years (usually at least ten) of service in Japan by the erstwhile student. (I might add parenthetically that the three Armed Services provide a similar regimen of language training for officers destined to be serving in Japan). While I think we do as well as any country in training Japanese language officers, not everyone agrees. A recent article in Foreign Policy decried the small number of proficient officers in our Tokyo Embassy (4). One of our major problems, of course, is that only a few students enter intensive training with some prior knowledge of the language, since it is not widely taught as a modern language in high schools and colleges. The one exception to this general situation is the segment of officers who are of Japanese extraction and who have had previous exposure to the native tongue. Even here, the capability is diminishing rapidly with time.

As far as I can tell, no language officer in the Department of State has received instruction in technical Japanese, where a different and complex vocabulary is required. Specialists such as myself are not given formal language training because they are not expected to serve a sufficient number of years in Japan to warrant the investment. While I studied the language with devotion as an avocation during my tenure in Tokyo, I acquired only a modest capability which was not sufficient to handle technical or professional subjects. This may not reflect well on my own abilities, but in all honesty I do not believe that fluent, professional Japanese can be learned by the casual methods we employ in the U.S. to teach the Romance languages. Again, I caution that expectations should not be set too high in trying to increase the supply of language-proficient technologists in very short time periods. Fortunately, some forward-looking universities in the U.S. have been coming to grips with this part of the problem and have established intensive programs of instruction which have the attributes I have identified as being necessary for success. The Subcommittee will be hearing from representatives of these institutions and no more needs to be said along this line.

We must recognize that heretofore it has not been so easy for even a language-proficient foreigner to take up residence in Japan as a student, academic scientist or engineer, or as an employee of a Japanese private company. Japan has justified its reputation for being insular in this respect. Pressures for change have been great, however, both within Japan and outside. As part of a study that I have been conducting for the U.S.-Japan Advisory Commission, I have been examining this aspect of the bilateral relationship and have observed a markedly increased willingness in Japan to develop procedures and programs that will enable Americans to integrate themselves into the Japanese technical system. It remains to be seen whether this will come to fruition. Reservations still exist in Japan about the will of foreigners to learn the language and to live in that country under the same conditions as its citizens do. Likewise, it is still uncertain whether there are sufficient numbers of Americans willing -- even more important, enthusiastic -- about undertaking the experience.

This Subcommittee will be trying to determine what actions should be taken by the Government to enhance the availability and use of Japanese technical information. My personal conclusion is that the following actions or positions would be helpful and possibly vital:

1. The existing system of bilateral scientific and technolo-

gical agreements should be nurtured and endorsed by the Congress as a proven method of exchanging technical information on an equitable basis. However, more effort needs to be expended by the participating U.S. Government agencies and by the National Technical Information Service to publicize and to disseminate the documentation produced through these agreements to universities, industry, and the general public. As usual, the lack of funds for this purpose is a hindrance.

2. The National Science Foundation or possibly NTIS should be encouraged, perhaps through the authorization/appropriation process, to survey (a) current uses of Japanese technical information in various sectors, (b) the extent of knowledge about sources of this information, and (c) the value of information already obtained. This will not be an easy undertaking if done thoroughly and results might not be available for a year or two.

3. An assessment of the national capacity to offer Japanese language instruction is needed, with emphasis on scientific and technical specialization potential. If the supply/demand relationship is not in balance, the reasons for the inbalance should be determined. It is possible that the general decline in teaching foreign languages in universities has had a particularly adverse impact on Japanese language instruction because of the difficulties entailed in teaching that language.

4. A "current awaremess" catalog of readily available English-language sources of Japanese scientific and technological information, together with price and ordering data, is badly needed. This could be used to interest potential users as well as to avoid duplication or overlap of services by Government

agencies and private organizations. The proceedings of the MIT workshop are an excellent beginning (1), but updating and expansion will be required. The question is whether there is enough public interest to have this function performed as a commercial service or whether the Government should bear the responsibility and cost.

5. While a similar catalog of Japanese-language publications would be handy for specialists with language capabilities, they probably know most of the best sources already. Whether further effort needs to be expended on translation and abstracting of these sources can best be determined after the assessment suggested in (2) above is completed or equivalent information is obtained by other means.

6. Members of the House Science and Technology Committee are best equipped to insure that actions are not taken by the Congress or the Administration which could have a negative impact on increasing the flow of technical information to the U.S. I am thinking in particular of a proposal that has been made by a prominent American industrialist to cut off the admission of Japanese graduate students to U.S. universities if their courses of study would expose them to advanced but otherwise unclassified information in fields of high technology. There is no better way to chill the bilateral relationship and to enhance the possibility of retaliation than through such xenophobic schemes. Now is the time to be building bridges or reinforcing existing ones to Japan. If our scientific prowess and our economic success depend on going it alone, we are in for some serious trouble.

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Biographic Statement

Justin L. Bloom

Justin L. Bloom was born in Pennsylvania in 1924. He was graduated from the California Institute of Technology in 1948, with a degree in applied chemistry (with honor). He served from 1943 to 1946 in the U.S. Army, first as a mechanical engineering student at Syracuse University and then as a combat infantryman in the 69th Infantry Division.

Mr. Bloom has been employed as a chemical engineer or program manager by Shell Chemical Corporation, California Research and Development Co., Lawrence Livermore National Laboratory, and Martin Marietta Corporation. In more than 20 years with the U.S. Government he worked for the Atomic Energy Commission in various capacities, including being technical assistant to the Chairman of the AEC for several years. In 1973 he was transferred to the Department of State and in 1975 he was posted to the American Embassy in Tokyo as the Counselor for Scientific and Technological Affairs. In 1981 he was transferred to the American Embassy in London, in the same capacity. Mr. Bloom retired from the Senior Foreign Service in March 1983 with the personal rank of Minister-Counselor. He is now self-employed as a consulting engineer in Potomac, Maryland.

Mr. Bloom is a Fellow of the American Association for the Advancement of Science and a member of the American Institute of Chemical Engineers. He has published many articles in the technical literature and holds three patents. He has received the AEC's Sustained Superior Performance Award, the Department of State's Meritorious Honor Award and two Performance Bonus Awards, and a Presidential Meritorious Service Award.

Mr. **Walgren**. Thank you very much, Mr. Bloom.

Just briefly, is the Japanese system as open in its publishing within the country as ours is? As I understand our system of scientific research and information exchange, there is this—this real ethic of getting it out there across the board, across the whole scientific community of this Nation for review and repetition, confirmation.

Are the Japanese technical developments, are they in the same kind of system that encourages, at least within their country, the same kind of breadth of publication?

Mr. **Bloom**. Mr. Walgren, very much the same.

The Japanese, if anything, have an advantage over us in that the country is so enormously literate. Japan claims a literacy rate of 99 percent in using one of the world's most difficult languages, and everybody reads and everybody likes to write for publication. This is one reason why there is such an enormous number of journals for a country with half the population of the United States.

Yes, in fact this is true. The Japanese do publish; they publish as often as American scientists and engineers do. The one constraint, as is the case in this country, is that proprietary information is not widely published there anymore than it is here. And, of course, that's usually the more juicier kind of technology.

Mr. **Walgren**. The whole problem seems to be getting Americans interested in exploring that avenue; we look out across our country and find so few students taking any foreign language, let alone taking Japanese. We certainly have a lot of work to do on our own capabilities.

When you look at our capabilities as a Nation, taking into account that we don't have students who are learning Japanese by and large; are we making an adequate effort to access that society for their information?

Mr. **Bloom**. Obviously not. I would be willing to make it stronger than that and say we absolutely are not making the appropriate effort for a country that is so important to us in every way: politically, economically, technically. The only encouraging sign is change; and one tends to grope for changes when things are so dismally poor. Fortunately, some of the American universities, the major American universities, are looking much harder at this now. Japanese is taught in several universities, for example, but largely for purposes of students of history: Asian history or Asian culture. And very little has been done in teaching technical Japanese.

And, as you might expect, technical Japanese is a whole new vocabulary. But there are changes, there are good signs, and you will be hearing from some representatives of universities that are trying to push this change.

The basic problem is that we are starting from such a low base. I only personally know a handful of people in the whole United States who are fluent in technical Japanese. I could almost count them on the fingers of both hands. I don't know everybody, of course, but there are very, very few people who have this capacity.

Mr. **Walgren**. Can you make any assessment of what an adequate effort would be and how far we fall short? I know that's such a vague invitation, but I am thinking is there any way that we can make some rough approximation of where we are in terms of the numbers of people whose energies are directed in that area, and where we think we ought to be?

Is there any comparison, for example, with German efforts, to access the German industrial literature and the like, that we could use as a yardstick?

I gather that the United States is much more able to have access to German and Western-European developed science than to Japanese developed science because of the cultural direction from which we've come.

Mr. **Bloom**. Well, I think you've spelled it out correctly. As a person who minored in German in college thinking that I would need this to understand the German technical literature and who in later years never used German for this purpose, I don't know quite how to respond to your question, except to say that there has to be a great motivation in the case of people who study Japanese.

It is not like learning German or French or Italian, or the other romance languages, because of this problem of syntax particularly, but for many other reasons, too. There are some experts in this room who can comment much better than I.

I personally have studied Japanese for all the time that I've been involved with Japan and I am far from fluent, because I've studied it as an avocation, as a hobby. You cannot learn Japanese that way. You can learn French, you can learn German, you can learn Spanish, that way, but you can't learn Japanese that way. As I say in my prepared testimony, the State Department teaches professional Japanese and 2 years of full-time study gets you to where you are turned loose in the country. And I don't know too many people who are engineers and scientists who are prepared to take 2 years out of their life to have an equivalent level of comprehension—to take 2 years out of their life and do nothing but study Japanese.

That's a pretty tough recipe to lay before somebody. And the only way it will ever be accomplished is by people having an interest, a commitment to understanding Japan as a country, as a people, as a culture, combined with the science and technology aspect of it.

Mr. **Walgren**. How would you compare our present ability to access Western European scientific information and our present capability to access Japanese scientific information?

Mr. **Bloom**. I understand that very clearly. Theoretically, the problem should be the same, but in actuality you find that with the possible exception of France, which insists that its publications be in French, all the—all the other European countries are publishing their scientific work in English, for all practical purposes. There are some exceptions always, but European scientists and engineers all speak English, and you can communicate without really studying the language of those countries.

They write in English for the same reason the Japanese do, that is, in Europe with a multiplicity of languages, they know that Americans, who are the world leaders in science and technology, are not going to learn Swedish, French, German, Spanish, Italian, and all the other languages of Europe. It's incumbent upon them to be the ones who learn English, and that in fact happens.

The same situation holds in Japan. Obviously, there's a huge body of information that never sees the light of day in English because the cost of translation and the volume to be translated is just too large. But, after all, the Japanese are translating more information than I have ever been able to read, and they are paying for it. The reason why is they want other people to read it. So that aspect makes it at least somewhat similar to the situation in Europe.

But for the large volume that isn't translated, then the only recourse is to obtain translation services, and others are probably more competent than I to tell you whether the volume of such services, the potential volume of such services, is sufficient to handle supply needs.

My problem still remains, though; I want to make sure that people use this information after somebody has gone to all the expense of translating it. And I just don't see that yet. If it's true, then I would be very encouraged about the outlook for our country. I think then we would have the proper outlook if I knew that we would use all the information that we could obtain from Japan.

Mr. WALGREN. Thank you very much.

Let me recognize my colleagues. Mr. Dymally?

Mr. DYMALLY. Just a brief comment, Mr. Chairman.

We passed a science and math bill and one of the significant parts of the bill was taken out, that portion having to do with language, because the authors of the bill—and it is a joint bill between the Education and Science and Technology Committees—felt that it was important for scientists to understand foreign languages and to be able to transfer, I mean to translate. And their collective wisdom did not prevail. The bill is now in the Senate.

Would you testify in support of putting that amendment back into that bill?

Mr. BLOOM. Absolutely. I hope I am an intellectual and, therefore, I hope that I can say authoritatively that the more knowledge we have, the better off we are. And language is a barrier in many ways to the exchange of knowledge and we need to do something about being more proficient in all foreign languages. I don't limit myself to Japanese in that respect.

Mr. BOEHLERT. Will my colleague yield for a moment, please——

Mr. DYMALLY. Yes.

Mr. BOEHLERT [continuing]. I am getting nervous now. I didn't realize foreign language was taken out. We insisted on it in the committee and there was no separate vote on the floor that I know of.

Mr. DYMALLY. No, not on the floor.

It was taken out in committee.

Mr. BOEHLERT. But we ended up having it——

Mr. DYMALLY. There's another bill that Mr. Simon had on the floor.

Mr. BOEHLERT. Wasn't that science or——

Mr. DYMALLY. Yes.

Mr. BOEHLERT. Excuse us while we have a colloquy here, if you will, because——

Mr. DYMALLY. In a subsequent bill he got it on the floor.

Mr. BOEHLERT. OK, good, fine. Thank you.

Mr. DYMALLY. Yes.

Mr. **Boehlert**. I was getting nervous.

Mr. **Dymally**. Thank you very much.

Mr. **Boehlert**. Thank you, sir.

Mr. **Walgren**. Thank you, Mr. Dymally.

Mr. Boehlert?

Mr. **Boehlert**. Yes, thank you, Mr. Chairman.

Mr. Bloom, first of all, I want to thank you for your outstanding testimony. It's very coherent and even I can understand it.

Mr. **Bloom**. Thank you, sir.

Mr. **Boehlert**. But last year the committee talked about having NTIS do a study, and when you are talking about the supply-demand relationship, and I notice in here, in your testimony, you are talking in terms of NSF. Do you have any feelings, strong feelings, one way or another?

Mr. **Bloom**. Yes.

Mr. **Boehlert**. You are after the result, you don't really care who gets it. Is that——

Mr. **Bloom**. Well, actually, I am a strong supporter of both organizations, NSF and NTIS. Now, they each have a different kind of role to play. After all, NTIS is a purveyor of technical information, largely Government technical information.

And NSF has an interest in seeing that American scientists are well informed. NSF has one of the more successful bilateral programs with Japan, where I estimate something like at any one time 1,000 American scientists have some involvement with Japanese counterparts in every facet of science and technology.

Mr. **Boehlert**. Um-hum.

Mr. **Bloom**. The NTIS cannot do that. NTIS is not an organizer of bilateral technical relationships; NSF is. But the two organizations could work better together, I think. To be frank, I think one of the things that has always bothered me is that NTIS always has to sell its documents. That may not be a popular thing to say today in Washington but, after all, if its purpose is to get information to the technical public, one has to question why does it have to sell it? Or at least sell it at full cost, or something like that.

Mr. **Boehlert**. Well, it's a very modest price. I mean, that's one of the agencies we all point to with great pride, sort of paying their way. [Laughter.]

Mr. **Bloom**. I understand that, of course, it's one of the few Government agencies that operates, I think, without the benefit of congressional appropriations, it operates on revenues. That's good if you are talking about economics. It's not necessarily good if you are talking about disseminating technical information.

I don't know how many people are constrained from buying NTIS reports because they may not have the money for it, the graduate students——

Mr. **Boehlert**. Would you hazard a guess? I mean, the NTIS publications are very inexpensive, aren't they?

Mr. **Bloom**. Well, I give you my own personal view, that's all I can do—I am an engineer, and NTIS publishes a lot of stuff that I would like to read but if I have to subscribe to a service in a field, it means several hundred dollars. And I'm retired now, and I'm watching my pennies, and I don't pay that money. [Laughter.] But I'm a peculiar example. Corporations, I'm sure, buy this information, others—others, you know, universities, libraries, buy this information—so really money isn't the constraint.

But, I think maybe one thing that NTIS could do, for example, would be more in the way of having conferences, or seminars, on technical information, particularly foreign technical information, where they could have an interchange; find out what consumers really need, and, and disseminate some of this information, maybe for free.

Mr. **Boehlert**. Um-hum.

Mr. **Bloom**. That's good advertising in other kinds of industries, so maybe some giveaways would be useful in this business too.

Mr. **Boehlert**. They are doing such a fine job. You are correct—when they come before us we are almost saying: "Don't you need something more? Can't we give you something more?" And it's very unusual today. [Laughter.]

Thank you very much for an outstanding statement.

Mr. **Bloom**. Thank you——

Mr. **Boehlert**. I appreciate it.

Mr. **Bloom** [continuing]. I appreciate it.

Mr. **Walgren**. Mr. Skeen?

Thank you, Mr. Boehlert.

Mr. **Skeen**. Thank you, Mr. Chairman.

And I would like to ask Mr. Bloom: The NTIS, though, is still considered fairly nominal. How well used is this and also, what information services, if any, are there in the so-called private sector? I may have missed this in your testimony, and I apologize if I cause you to be redundant.

Mr. **Bloom**. No, you are not redundant, Mr. Skeen.

I don't think that NTIS competes with the private sector to any great extent. And there is a great deal going on in the private sector in disseminating technical information. The professional societies do this, of course, through the publication of journals, and more and more, I think one will find that the number of articles published by authors with Japanese surnames is increasing steadily.

Besides professional journals, there are abstracting and indexing services, which don't create information themselves but examine what is published by everybody else. And you will hear from one or more of these organizations during the course of these hearings.

This is a very valuable service because no one today can hope to read all of this material. One must be very restrictive in how one approaches reading technical literature or if you want to do any other work, unless you want to spend your whole lifetime just reading, you can easily do this and you still won't read it all. So you have to be very selective and you do that through abstracting and even more narrow taking of cross sections than that. Abstracts after all, are already maybe 100 or 200 words; and today people use what are called key words, where you sort out the information that you want to look at more carefully by picking words that narrow the field for you.

For example, I just did a literature survey looking for articles on recovery of uranium from sea water in Japan. Well, you don't start by looking for all the articles published in Japan on uranium. There are thousands and thousands——

Mr. **Skeen**. Or on sea water.

Mr. **Bloom**. Nor on sea water.

So you do a sort and the computer does this for you. You sort it—by the way, I did this at the Library of Congress—and you sort by Japan, by uranium, by sea water, and by recovery. And when you do four sorts like that then you come up with 24——

Mr. **Skeen**. Cross sections?

Mr. **Bloom** [continuing]. And then you can read 24 articles very easily.

Mr. **Skeen**. But——

Mr. **Bloom**. So that's the way you have to approach the literature, and NTIS offers this kind of service and so do the professional commercial indexing and abstracting services. I have not heard any complaints about overlap, or competition. I think everybody has more or less staked out his own area of expertise. And today with computers and electronic transmission of information, the business is growing rapidly because they can access so much more information than they could before.

Mr. **Skeen**. Is there a lot of cross communication and cross check with these folks? And I am assuming there probably is because of the character——

Mr. **Bloom**. Well, in the case of Japan, we found that there hadn't been too much. MIT was remarkable in foreseeing a lot of what we are talking about here today and tomorrow, and arranged a conference that was held in January of 1983 in the Boston area. As far as I know, for the first time specialists in collecting and disseminating Japanese scientific and technical information got together. We each knew somebody else in the room but we didn't all know everybody else. And I found that a very stimulating experience.

And my own recommendation at the time was that there should be a formalization of this kind of collective expertise to avoid duplication, avoid stepping on each other's toes. So far I don't think we've found very much overlap.

Mr. **Skeen**. Well, Mr. Bloom, I think you had an excellent idea as far as the NTIS providing some seminar or something of that—and it could, I think, lead to the kind of closer communication between these various services and finally arrive at some kind of a centralized system of handling that information, not only from Japan, but any other nation——

Mr. **Bloom**. True.

Mr. **Skeen** [continuing]. On any other particular topic. And I think it is just amazing that we've gone this long and we haven't really gathered it up that close at this point, because we are looking over one another's shoulders so much of the time.

But I want to thank you very much for your testimony and thank you, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Skeen.

Mr. **Bloom**. Thank you, Mr. Skeen.

Mr. **Walgren**. Well, ~~on behalf~~ of the committee, thank you very much for your presentation; we appreciate it.

Mr. **Bloom**. Thank you, sir.

Mr. **Walgren**. The next witnesses we have asked to group together to form a panel, largely out of the interest of time, Herbert

Landau, the president of Engineering Information, Inc., and Anthony Polsky, the president of Cathay Counsellors Groups, and as I understand it, he will be accompanied by Dr. Toshio, and I cannot, but take a stab at what I am told might be Tsukahira—is that how it's said?

Dr. **Tsukahira**. Tsukahira.

Mr. **Walgren**. Tsukahira, fine.

Well, I appreciate all of you coming, and let me ask you to proceed. Mr. Landau, why don't you start with your testimony and then we will turn to Mr. Polsky.

STATEMENTS OF HERBERT B. LANDAU, PRESIDENT, ENGINEERING INFORMATION, INC., NEW YORK, N.Y., AND ANTHONY POLSKY, PRESIDENT, CATHAY COUNSELLORS GROUP, INC., BEAVERTON, OREG. AND WASHINGTON, D.C.; ACCOMPANIED BY TOSHIO G. TSUKAHIRA, ASSOCIATE

Mr. **Landau**. Thank you, Mr. Chairman.

Mr. Chairman, members of the committee:

It is a privilege to have been invited here to meet with you today. The topic of this afternoon's hearing is one which we consider to be of critical national import and indeed has been a subject very much in the mind of my organization, and particularly my two colleagues who are behind me, Gloria Moline and Mary Berger, for the past 2 years.

Engineering Information, Inc., is a not-for-profit information service. We are celebrating our 100th anniversary this year and for the past century we have been dedicated to collecting, analyzing, abstracting, and indexing the world's engineering literature.

I joined EI approximately 2 years ago and met with our board of directors and trustees. We are a private, self-supporting organization getting no subsidies. We are self-governing with a board of trustees and directors, and I believe you have copies of our annual report—these are listed in the back of the report. This board represents a cross section of American industry, academia, Government, and professional societies interested in information and engineering.

When I asked this group what they thought our key priorities were, and particularly what my key priorities should be as a new CEO, a very strong consensus came out and supporting our—our increasing our activities in covering the Japanese technical literature. Particularly the representatives of some of the larger corporations in the United States indicated that this was one of their key information problems.

We embarked on this project in mid-1982; did some research. And I am sure this will be alluded to by some of the witnesses tomorrow—we found that out of approximately 9,000 Japanese scientific and technical periodicals—Dr. Bloom mentioned his analysis indicated 10,000, so at least we are in the right ball park. We found that about 4,000 of these fell into the area of applied science or engineering. Of these we estimated, in analyzing what the major abstracting and indexing services cover, only about 14 percent of this total, or roughly 600, periodicals are covered. Two-thirds of these 600 are English language Japanese periodicals.

This is understandable when one considers the difficulties that services such as mine have in acquiring the literature of Japan and the difficulty and cost involved in translating these articles into English.

So essentially the current coverage are of those journals that are easy to acquire and those which have some in part or in whole have English language articles or abstracts.

Our organization's current coverage of Japan, Japanese literature, amounts to about 130 periodical titles or about 8,500 articles per year.

We looked at the problem and identified the key areas of interest to the engineering community of the United States. These are broken down into 15 major areas. These are in the written testimony. I can go over these now or we can just leave it at 15. The total number of journals from Japan that we identified in these 15 areas amounted to about 1,000 titles.

We then looked at whether or not it would be feasible to provide an information service at cost for the U.S. community for these titles. We determined that this is a very expensive proposition. In looking at certain areas such as a subset of these 15 areas which cover all of engineering, just the areas of electronics, data processing, telecommunications, we identified 450 titles amounting to about 35,000 papers per year. The cost for mounting a service such as this would be roughly half a million dollars per year. The cost for mounting a complete service covering virtually all of engineering, key engineering journals coming from Japan, would amount to about $800,000 per year for 70,000 papers.

We did attempt to find sources of funding and did meet with various representatives of government—were given morale support, but basically were told that we would have to pursue this on our own.

In December, we began to contact representatives of industry primarily; since then we have sent out 200 letters to industry, asking if they would be interested in supporting a service such as this.

We have proposed that we get initially, to make this run, approximately 20 subscriptions, is what we would need to mount the service—the selective service covering electronics and data processing would cost about $24,000 per year for 12 monthly reports in both paper and computer readable form covering the Japanese literature; the expanded service covering all of engineering would be about $45,000 per year.

Thus far, out of the 200 letters we sent out in December, we have been somewhat underwhelmed; we have three positive responses, three organizations have said they would subscribe; we have a total of seven more definite maybes. But at this point if we do not receive any more positive responses, we probably will have to abandon our attempts to cover this literature. We had said we would make our decision—a go, no-go decision—by March 1. We are extending it to March 31, as some organizations said they needed a bit more time.

We think this is a critical national need and we feel someone should do this. There had been mention made of NTIS covering this, I believe—and I am sure the representative of NTIS will correct me if I am wrong—that NTIS does cover the technical report literature, not the open journal literature as we are proposing to do.

We think there are several risks involved in covering this, and even if we do get complete support, there definitely will be a risk in attempting a service. The risks are that the literature is difficult to obtain; of the costs, we had estimated, the cost I had mentioned, we estimate that 30 percent of that total cost would be the cost in acquiring the journals, both subscription costs and airmail postage to get them in in a timely basis; 60 percent would be the cost for translation and indexing—assuming one could find the translators. And we have discovered that there is a critical gap, critical need, a lack of qualified Japanese, bilingual Japanese—English technical translators in the United States; so we are being optimistic hoping we could do this.

And those are two major risks. But we are willing to attempt this if we can find some source of funding. That basically is the gist of my testimony. You have the written account, gentlemen, and I am open to answer any questions you might have.

[The prepared statement of Mr. Landau follows:]

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Testimony To

The Sub-Committee on Science Resources and Technology

of the

House Committee on Science and Technology

on the subject of

ACCESS TO JAPANESE TECHNICAL INFORMATION

March 6, 1984

submitted by

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The Engineering Index® Monthly, The Engineering Index Annual, Energy Abstracts, Bioengineering Abstracts, and the Compendex® and Ei Engineering Meetings® databases

I. INTRODUCTION

Engineering Information, Inc. is pleased to present this testimony on access to Japanese technical information.

Engineering Information, Inc. (Ei) is a private sector, not-for-profit organization dedicated to serving the information needs of the engineering and related professions on a world-wide basis. It publishes The Engineering Index Annual and The Engineering Index Monthly, the COMPENDEX and Ei ENGINEERING MEETINGS databases, and a variety of related publications. (See Attachment A).

Part II of this testimony describes briefly Ei's mission, governance structure and its products and services. Part III reports the results of Ei's research on access to Japanese engineering literature in the U.S. through Western abstracting and indexing services and Part IV describes briefly Ei's proposed Japanese Awareness Service.

II. Ei'S MISSION, GOVERNANCE STRUCTURE, AND PRODUCTS AND SERVICES

Mission

Ei was founded in 1884 by Dr. John Butler Johnson, a professor of Civil Engineering at Washington University, St. Louis, Missouri, who was concerned with the lack of access to literature in engineering. As a solution, Dr. Johnson compiled a collection of document citations and abstracts which he termed "Index Notes" and published in 1884. The guiding philosophy behind this index from the start has been "to index only articles of permanent value and to give such a short, concise, but adequate description of the article as would enable one seeking information on the given subject to determine whether or not it would be worth their while to obtain or consult the article."

Ei's current mission incorporates and expands on Dr. Johnson's philosophy. It is:

> To disseminate engineering, scientific and technical information by means of publications, electronic media, other media and instructional services, descriptive indexes and annotated bibliographies, and by other appropriate methods for the use of libraries, educational institutions, industry, governmental agencies, the engineering and scientific community and the interested public. Included in these purposes are the collection, examination, abstracting, indexing and dissemination of information concerning engineering, scientific and learned publications, scientific and educational events, engineering products, institutions and entities, databases, biographical sources, and other sources of engineering information in whatsoever form originating throughout the world.

Governance

Ei is an independent corporation, not part of a professional society or any other organization. It is governed by a Board of Directors and Board of Trustees. These Directors and Trustees are drawn from all segments of the engineering, scientific and information world and represent leading universities, industrial concerns, professional societies, government agencies, publishers and technical libraries. Ei's President serves as Chief Executive and Operating Officer and reports to the Board of Directors.

Overview of Ei Products and Services

Over the past 100 years since Dr. Johnson first introduced "Index Notes", Ei has kept abreast of, and often paced, the state-of-the-art of information technology in response to the needs of the engineering community.

In 1928, Ei introduced what was perhaps the world's first selective dissemination of information (SDI) awareness system, the Ei CARD SERVICE. Operated continuously from 1928 to 1975 (when the advent of online services rendered it obsolete) the CARD SERVICE (known as CARD-A-LERT in its later years) provided the engineering community with daily and weekly mailings of document abstracts printed on index cards.

In the early 1960s experimentation began with computer-readable magnetic tape subsets of the Engineering Index database. This exploratory research led to the introduction of Ei's COMPENDEX service in 1969. COMPENDEX (Computerized Engineering Index) is essentially a digital version of the Engineering Index Monthly publication. The COMPENDEX database has been commercially available online since 1973 and is now accessible internationally on nine online utilities in North America and Europe.

The Ei ENGINEERING MEETINGS database was introduced in July 1982. This database covers approximately 100,000 papers annually from the published proceedings of over 2000 engineering meetings.

To respond to the information needs of engineers working in specific, key interest areas Ei developed Bioengineering Abstracts, and Energy Abstracts. In 1984, Ei expanded its coverage of special areas by launching a series of Technical Bulletins, stand-alone bibliographies reviewing the state-of-the-art in key areas of high technology.

A review of Ei's coverage of worldwide scientific and technical literature during the past 100 years serves to indicate both the tremendous growth in that literature, and Ei's commitment in providing access to that literature. From 1000 records in 1884 Ei reached the one million record mark in 1954, the two millionth 21 years later in 1975 and the three millionth in 1984.

Table 1 lists key milestones in Ei's development.

III. COVERAGE OF JAPANESE ENGINEERING LITERATURE

Ei has received numerous requests over the last two years from representatives of major corporations in the United States for an information service that would help them keep abreast of important Japanese technological developments. Their requests stem from a need to remain competitive in national and international markets. To meet this need Ei has developed a proposal to provide a Japanese Awareness Service to be cooperatively funded by major U.S. corporations.

Prior to developing the proposal Ei researched existing Japanese technical literature and access to that literature through Western secondary services. In conducting this research, Ei has identified three major problem areas with regard to access to the Japanese applied science literature. They are:

(1) The large volume of Japanese applied science literature generated each year.

(2) The scant coverage of Japanese applied science literature by Western secondary services.

(3) The lack of English-language articles or translations of Japanese articles into English.

Studies* have shown that there are over 9000 Japanese scientific and technical periodicals of which 4000 fall under the general heading of Applied Science. Approximately 280,000 papers are published annually in these applied science journals-- more papers than the total annual worldwide coverage in both Ei databases.

Western secondary services cover selectively only 14 percent of the Japanese applied science journals. For example, Engineering Information, Inc. selectively indexed and abstracted approximately 8500 papers from 130 Japanese engineering periodicals during the period 1982-1983; for the COMPENDEX database; this compares to a total number of 220,000 records for this period from approximately 2000 world-wide journals. In 1982 and 1983 the Ei ENGINEERING MEETINGS database included approximately 1600 papers published in Japanese conference proceedings from a total of 160,000 papers indexed.

Reasons for scant coverage include the difficulty of acquiring and translating the articles, and the selection policies of the secondary services (i e., the organization's committment to balanced geographic and subject coverage of the literature in the scope of their mission.)

U. S. engineers are generally not fluent in Japanese which poses a serious barrier to their tracking of Japanese technology. Compounding the problem is the fact that only 19 percent of the Japanese Applied Science literature is published in English. Translations of the remaining 81 percent of the literature are not readily available and are very expensive to produce on demand. Western abstracting and indexing services generally cover primarily those Japanese periodicals that are published in English.

It is clear from these findings that current access to Japanese technical information does not adequately serve the information needs of U.S. industry.

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*Gibson, Robert W. and Barbara K. Kunkel. Japanese Scientific and Technical Literature; a Subject Guide. Westport, CT. Greenwood Press, 1981.

IV. Ei'S PROPOSED JAPANESE AWARENESS SERVICE

Ei has identified fourteen subject areas in which there are significant Japanese developments of critical interest to U.S. industry. These broad engineering areas are:

Aeronautics and Aerospace
Automatic Control
Bioengineering
Chemical Engineering
Civil Engineering
Computers and Data Processing
Electrical and Electronic Engineering
Materials Science
Mechanical Engineering
Metallurgy
Mines and Mining
Photo-optical Technology
Shipbuilding
Transportation

To our knowledge, no single Western abstracting and indexing service, nor any combination of these services adequately covers the Japanese literature in these engineering-related areas.

Description of the Service

The Japanese Awareness Service will provide access to information published in over 1000 strategically important technical periodicals published in Japan. A list of these journals, by subject area and title, is shown in Attachment B.

The proposed Japanese Awareness Service includes both print and digital access to the information collected and indexed by Ei. Subscribers to the service will receive the following:

- a monthly Ei JAS Announcement Bulletin, organized by general subject.
- if desired, a monthly magnetic tape of the Ei JAS database to run on the subscriber's own inhouse computer system.
- online access to Ei's JAS database.
- on-demand document delivery for all source articles covered by the service.
- on-demand translations into English of the full text of the Japanese papers covered by the service.

The database will include transliterated author names, translated author affiliations and titles, complete citations to source documents and subject descriptors. About 70,000 Japanese papers will be indexed. The database will be updated monthly.

Areas of Risk

In developing the JAS service, Ei has identified four major areas of risk. They are:

- Difficulty in acquiring Japanese professional and technical journals and other publications of interest.
- the shortage of skilled technical translators in the U.S.
- the high costs of developing and maintaining the service.
- the lack of funding.

The acquisition of those journals and other publications identified by Ei's research is a major undertaking in terms of both time and cost. Several options for journal acquisition are actively under investigation including direct-air mail subscription and the use of both U.S. and foreign subscription agencies. However, political constraints may preclude the acquisition of some of the desired titles by organizations outside Japan.

Once acquired, the journals will require translation, which highlights the second area of risk that Ei has identified: an acute shortage of translators skilled in translating technical Japanese into English.

A service of the type proposed will need to be timely if it is to be of value. This will require additional staff dedicated to the project and an expanded database production system.

Ei is currently seeking funding for the JAS from major U.S. organizations. If sufficient funding is not forthcoming by March 31, 1984, Ei will have to abandon what it considers a critically important information service to U.S. industry.

V. CONCLUSION

Engineering Information, Inc. as part of its mission, is committed to providing U.S. industry with access to the important worldwide information in the broad fields of engineering. Ei recognizes the critical need for expanded coverage of Japanese engineering literature. Its Japanese Awareness Service is one proposed solution to the lack of U.S. access to Japanese scientific and technical information. The JAS as proposed by Ei illustrates the effort a private sector organization is willing to undertake to provide the information the country, the Congress, and Ei's users have identified as essential to the economic health of U.S. business and industry.

ATTACHMENT A

ENGINEERING INFORMATION'S PRODUCTS AND SERVICES

ENGINEERING INDEX MONTHLY

A month-by-month review of the latest developments in engineering and related technical disciplines presenting abstracts of over 10,000 articles from around the world.

ENGINEERING INDEX ANNUAL

A cumulative edition of each year's Engineering Index Monthly issues with author and author affiliation indexes. Available in print from 1959 and in microfilm from 1884.

COMPENDEX

The digital database version of the Engineering Index Monthly, providing abstracts of articles from journals, monographs, standards and reports. Available from major online vendors as well as in machine-readable form on a lease/license basis.

Ei ENGINEERING MEETINGS

Ei's digital database providing authoritative, indepth coverage of individual papers published in the proceedings of approximately 2000 worldwide technical conferences. Available through major online vendors and in machine-readable form on a lease/license basis. A print version will be made available in 1984.

ENERGY ABSTRACTS

A specialized monthly publication providing information on conventional and alternative energy sources.

BIOENGINEERING ABSTRACTS

A specialized monthly publication on biotechnology.

SHE (Subject Headings for Engineering)

A listing of Ei's controlled vocabulary.

PIE (Publications Indexed for Engineering)

An annual publication supplying information on publications covered by Ei.

SUBJECT HEADING GUIDE TO ENGINEERING CATEGORIES

Lists Ei's controlled vocabulary by CAL classification codes.

TECHNICAL BULLETINS

A new series of bibliographies in current high interest technological areas.

CUMULATIVE INDEXES

Quick indexes to 1973-77 and 1978-81 Engineering Index Annuals. Includes number translation tables to convert Monthly accession numbers to Annual numbers and vice versa.

COMPENDEX SEARCH MANUAL

Provides comprehensive data for online use of COMPENDEX with specific online vendor sections.

TABLE 1 - CHRONOLOGY OF EI PRODUCTS AND SERVICES (1884 - 1984)

Date(s)	Event	Scope
1884	"Index Notes" introduced in Journal of the Association of Engineering Societies.	Less than 1000 abstracts selected from 100 journals indexed under 1375 subject headings and cross references.
1892	Volume I of the cumulative, Descriptive Index to Current Engineering Literature, 1884-1891, compiled.	Approximately 11,000 abstracts published.
1896	Volume II Cumulation termed The Engineering Index 1892-1895, published.	Approximately 6000 entries from 62 journals.
1901	Engineering Index cumulative Volume III, 1896-1900 published.	Approximately 40,000 entries from 200 journals.
1906	Engineering Index cumulative Volume IV, 1901-1905, published. Published as regular annual volume from 1906.	Approximately 50,000 entries from 250 journals.
1919-1933	Monthly publication of The Engineering Index in the Journal of the American Society of Mechanical Engineers (known as Mechanical Engineering, 1920 -), with annual cumulations.	Production of from approximately 10,000 to 50,000 abstracts per year.
1919	Cooperative arrangement with Engineering Societies Library (ESL) established providing copies of all documents covered by Ei.	All key journals received by ESL are reviewed (1200 in 1919, over 3,500 in 1982).
1928-1975	Ei Card Service (later known as CARD-A-LERT) offered as a daily and weekly selective dissemination of information awareness service.	Index cards covering 50,000 abstracts selectively distributed to subscribers among 223 to 249 subject classes.
1954	One millionth Ei record published.	
1962	The Engineering Index Monthly introduced.	
1963-1969	Experimental plastics and electrical engineering awareness bulletins (Plastics Monthly and Electrical/Electronics Section) and CITE (Computer Information Tapes for Engineers) services offered.	1000 electrical and 500 plastics abstracts per month sent to over 500 subscribers. Plastics engineering coverage totalled 30,000 abstracts between 1965-69 and electrical/electronics coverage totalled 60,000 abstracts from 1965-67.

Date(s)	Event	Scope
1969	COMPENDEX (COMPuterized ENgineering InDEX) monthly magnetic tape service launched.	Approximately 5000 digital records per monthly tape.
1970	Microfilm edition of the Engineering Index Annual offered.	Retrospective files (1884-1927, 1928-1958, 1959-1969) plus annual updates.
1973	On-line access to Ei's COMPENDEX file offered by commercial vendors.	
1974	Monthly Bioengineering Abstracts and Energy Abstracts offered in print format as subsets of Ei database.	Bioengineering coverage of approximately 1500 abstracts per year and energy coverage of approximately 20,000 abstracts per year.
1975	Two millionth Ei abstract published	
1979	Cumulative Index, to the Engineering Index Annual and the Engineering Index Monthly (1973-1977) published.	Subject and author index to approximately 410,000 items.
1981	Engineering Information Search service (EISS) introduced.	Custom literature searching and advisory services.
1982	Cumulative Index to the Engineering Index Annual and the Engineering Index Monthly (1978-1981) published.	Subject and Author index to over 400,000 items.
1982	Ei Engineering Meetings database introduced.	Annual listings of 100,000 papers from 2000 conference proceedings.
1983	Engineering Information Technical Bulletin series launched.	Stand-alone bibliographies reviewing the state-of-the-art in key areas of high technology.
1984	Three millionth Ei record published.	

ATTACHMENT B

TITLES COVERED BY THE JAPANESE AWARENESS SERVICE

In this attachment we list, by broad subject area, titles of the journals, reports, and other serial publications to be covered by the Japanese Awareness Service.

CONTENTS

Aeronautics and Aerospace....................................B1

Automatic Control..B2

Bioengineering...B4

Chemical Engineering...B6

Civil Engineering..B8

Computers and Data Processing................................B10

Electrical and Electronic Engineering........................B13

Materials Science..B19

Mechanical Engineering.......................................B21

Mettallurgy..B23

Mines and Mining...B25

Photo Optical Technology.....................................B26

Shipbuilding...B27

Transdisciplinary..B28

Transportation...B30

Aeronautics and Aerospace (18 titles)

(See the section on transportation for other modes of transport)

The titles included in this section contain but are not limited to, technical information in the following general areas: Aerodynamics; Aerospace Research and Support Facilities; Aerospace Sciences; Air Transportation and Flight Safety; Aircraft Design, Testing and Performance; Aircraft Propulsion; Guidance and Control.

Titles

Aero Fan Magazine
Aircraft Engineering
Aircraft Nuisance Research and Control
Aviation Electronics Technical Bulletin
Aviation Journal
Bulletin of the Institute of Space and Aeronautical Science, University of Tokyo
Electronic Navigation Research Institute Papers
Journal of the Japan Society for Aeronautical and Space Sciences
Journal of the Society of Japanese Aerospace Companies
JPE Aviation Report-Weekly
NAL Technical Report
Pilot
Preprints of the Symposium of the National Aerospace Lab.
Proceedings of Airport Engineering
Report of the Institute of Space and Aeronautical Science, Univ. of Tokyo
Report of the Meeting on Airplane Structure
Transactions of the Japan Society for Aeronautical and Space Sciences
Trends in Aeronautics and Space Technology

Automatic Control (78 titles)

(For Computers see section on this subject)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Adaptive Control Systems; Automatic Control Systems and Equipment; CAD/CAM; Man-Machine Systems; Nonlinear Automatic Control Systems; Numeric Control; Optimization of Control Systems; Robotics; Telecontrol Equipment.

Titles

Advances in Engineering
Automation
Automation Technique
Automation Technology
Bulletin of the Faculty of Engineering, Hiroshima Univ.
Bulletin of the Japan Society of Precision Engineering
Bulletin of the Kumamoto Institute of Technology
Bulletin of the Research Laboratory of Precision Machinery and Electronics (Tokyo Institute of Technology)
Collected Papers of the Faculty of Engineering, Kobe Univ.
Die and Mold
Engineering and Technology
Engineering Information
High Precision
IE Review
Industrial Machinery
Industrial Science and Technology
Industrial Sciences
Industries of Japan
Industry
Industry and Industrial Products
Instrumentation
Instrumentation
Instrumentation and Automation
JEOL R & D
J.E.T.R.O. Japan's Industrial and Technological Bulletin
Japan Machinist
Journal of Labor Saving & Automation
Journal of Technical Research Institute
Journal of the Japan Electric Measuring Instruments Manufacturer's Association
Journal of the Japan Machinery Federation
Journal of the Japan Society of Mechanical Engineers
Journal of the Japan Society of Precision Engineering
Journal of the Society of Instrument and Control Engineers
Journal of the Textile Machinery Society of Japan
Machinery for Remarkable Development
Machinist (World Progress of Production Engineering)
Magazine of Industrial Engineering
Mechanical Design
Mechanical Engineering Applications
Memoirs of Faculty of Technology, Kansai University
Monthly Technical Review
Nagoya Univ., Faculty of Engineering, Automatic Control Laboratory, Research Reports
New Machine Tools

Papers of Technical Meeting on Railway and Transportation, Institute of Electrical Engineers of Japan
Papers of Technical Meeting on Rotating Machines, Institute of Electrical Engineers of Japan
Papers of Technical Meeting on Switching and Protective Devices, Institute of Electrical Engineers of Japan
Papers of Technical Meeting on System Control, Institute of Electrical Engineers of Japan
Papers of the Symposium on Technology Forecasting
Plant Engineer
Proceedings of Precision Industrial Research Institute of Nagano Prefecture
Proceedings of the Symposium of the Japan Society of Mechanical Engineers
Proceedings of the Symposium of the Japan Society of Mechanical Engineers, Lecture Meeting
Production and Technique
Promoting Machine Industry in Japan
Quality, J.S.Q.C.; Journal of the Japanese Society for Quality Control
RAM
Report of Computer Center, Tokyo Institute of Technology
Report of Computer Laboratory, Tanashi Branch of Electrotechnical Laboratory
Report of the Science and Engineering Research Laboratory, Waseda Univ.
Research Bulletin of the Hiroshima Institute of Technology
Research on the Economics of Mechanization
Research Reports of Automatic Control Laboratory, Faculty of Engineering, Nagoya Univ.
Review of Modern Technology
Robot
Science of Machinery
Standardization and Quality Control
Sumitomo Shipbuilding & Machinery
Survey on Technological Development in Japan
Systems and Control
Systems Monthly
Technical Information, Industrial Research Institute, Kochi Prefecture
Technical Paper of the Institute of Electronics and Communication Engineers of Japan
Technology
Technology and Industry
Tool Engineer
Toyota Technical Review
Transactions of the Japan Soceity of Mechanical Engineers
Transactions of the Society of Instrument and Control Engineers

Bioengineering (56 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Acupuncture; Applications of Engineering Technology to Diagnostics, Therapeutic and Patient Monitoring Procedures; Artificial Organs; Biomedical Engineering; Biomedical Instrumentation; Environmental effects on Humans; Genetic Engineering.

Titles

Acupuncture
Advances in Biophysics
Annual Report of the Tokyo Metropolitan Research Institute for Environmental Protection
Artificial Organs
Aviation Medicine
Biomechanisms
Biophysics
Biotronics
Clinical Electroencephalography
Collected Lectures and Essays of the Japan Medical Ultrasonics Society
Computers in Medicine
EPI Environmental Protection & Industry
Ecological Review
Electric Power and Pollution
Energy and Pollution
Energy and Pollution Control
Environment Control in Biology
Environmental Conservation Engineering
Industrial Sanitary Engineering
Industry and Environment
Japanese Journal of Biometeorology
Japanese Journal of EEG and ENG
Japanese Journal of Ecology
Japanese Journal of Medical Electronics and Biological Engineering
Japanese Journal of Nuclear Medicine
Japanese Journal of Physical Therapy and Occupational Therapy
Japanese Journal of Radiological Technology
Japanese Journal of Transplantation
Japanese Medical Ultrasonics
Journal of Biochemistry
Journal of Clinical Engineering
Journal of General and Applied Microbiology
Journal of Japan Contact Lens Society
Journal of Japan Society of Air Pollution
Journal of Japanese Biochemical Society
Journal of Radiation Research
Journal of Solid Wastes Management
Journal of the Japan Society for Dental Apparatus and Materials
Journal of the Japan Water Treatment Biological Society
Journal of the Society of Biomechanisms, Japan
Journal of Transportation Medicine
Life Science
Materials Related to Gene Manipulation
Medical Electronics
Medical Electronics
Medicine and Instruments
News on Biological Strains Conservation
Pollution Prevention Manager
Proceedings of the Japan Society of Ultrasonics in Medicine
Radiological Sciences
Report of Population Ecology Assoc.
Report of Radiation Biology Research Communication

Reports of the Institute for
  Medical and Dental Engineering,
  Tokyo Medical and Dental University
Researches on Population Ecology
Safety Engineering
Safety Management

B5

Chemical Engineering (60 titles)

(For Plastics, Polymers and Rubber, see section on Materials Science)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Chemical Equipment; Chemical Products; Electrochemistry; Petroleum Technology and Products; Unit Operations; Unit Processes.

Titles

Bando Elastomer Report
Bando Transmission News
Bulletin of the Chemical Society of Japan
CEER, Chemical Economy Engineering Review
Chemical Engineering
Chemical Engineering, Japan
Chemical Factory
Chemical Industrial Economy
Chemical Industry
Chemical Machine Technology
Chemistry and Chemical Industry
Coal and Petroleum Bulletin
Coke Circular
Combustion
Combustion Research
Electro-Chemistry and Industrial Physical-Chemistry
Esso Oilways International
Explosives and Safety Maintenance
Fuel and Combustion
Idemitsu Petroleum Journal
Industry and Oil
Japan Chemical Industry Assoc. Monthly
Journal of Chemical Engineering (Special Issue)
Journal of Chemical Engineering of Japan
Journal of the Chemical Society of Japan
Journal of the Fuel Society of Japan
Journal of the Industrial Explosives Society, Japan
Journal of the Institute for Safety of High Pressure Gas Engineering
Journal of the Japan Gas Assoc.
Journal of the Japan Oil Chemists' Society
Journal of the Japan Petroleum Institute
Journal of the Japan Society of Powder and Powder Metallurgy
Journal of the Japanese Assoc. of Petroleum Technologists
Journal of the Kinki University Association of Applied Chemistry
Journal of the Society of Chemical Engineering, Japan
Journal of the Spray Coating Society of Japan
Liquefied Petroleum Gas
MOL
Micromeritics
Molten Salt
Natural Gas
Natural Resources and Energy
Oil Pressure
Painting Technology
Petro Chemical Engineering
Petro Chemical Journal
Petroleum and Petrochemicals
Petroleum Developing
Petroleum Industry
Plant and Process
Powder Engineering
Powder Process Engineering
Preprints of Symposium on Petroleum Chemistry, Japan Chemical Society

Quality
Recent Chemical Engineering
Reports of the Research
  Laboratory for Surface
  Science, Okayama University
Review of Physical Chemistry
  of Japan
Sumitomo Chemical
Transactions of NISSO Master
  Builders, Central Research
  Laboratory
Yuasa Technical Information

Civil Engineering (41 titles)

(Transportation is included as a separate section)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Air, Water, Soil, Pollution; Buildings; Coastal and Offshore Engineering; Construction Engineering; Construction Industry; Construction Materials; Foundations Engineering; Rail, Highway, Airport Structures and Facilities; Sewage Treatment; Soil and Rock Mechanics; Solid Wastes; Structural Design and Analysis; Surveying and Mapping; Traffic Control; Tunnels and Tunneling; Water Resources Management; Water Treatment.

Titles

Annual Report of Construction Method and Machinery Institute
Annual Report of Kajima Institute of Construction Technology
Annual Report of the Civil Engineering Research Institute, Hokkaido Development Bureau
Annual Report of the Society for the Promotion of Construction Engineering
Bridge and Foundation
Bulletin of the Earthquake Research Institute, University of Tokyo
Cement Industry Approach
Civil Engineering
Civil Engineering in Japan
Coastal Engineering in Japan
Comprehensive Construction Research
Concrete Block for Civil Engineering
Concrete Journal
Construction Machinery and Equipment
Construction Mechanization
Foundation Work
IEC/International Engineering Consultants
Journal of Shield Method Construction
Journal of Society of Steel Construction of Japan
Journal of Technical Lab. of Fujita Corp.
Journal of the Japan Society of Civil Engineers
Journal of The Japanese Society of Soil Mechanics and Foundation Engineering
Journal of Tokyo Construction Office, JNR Tokenko
Kinki Regional Construction Bureau Monthly
Monthly Bulletin of Construction
Monthly Magazine 'Kensetu' (Construction Engineer)
Monthly Report of Tohoku Regional Construction Bureau
News of Tokyo 2nd Construction Bureau, Japanese National Railways
Proceedings of the Annual Meeting of Soil Mechanics and Foundation Engineering
Proceedings of the Japan Society of Civil Engineers
Proceedings of the Symposium on Rock Mechanics
Report of Special Committee for Shrinking, Cement Association of Japan

Report of the Technical Research Assoc., Ministry of Construction
Reports of the Construction Engineering Research Institute Foundation
Soils and Foundations
Solid Wastes
Structural Engineering Symposium
Symposium for Civil Planning
Symposium on Soil Mechanics and Foundation Engineering
Technical Research Report of Hazama-Gumi Ltd.
Transactions of the Japan Society of Civil Engineers

Computers and Data Processing (102 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Computer Aided Design; Computer Architecture; Computer Graphics; Computer Networks; Computer Peripheral Equipment; Computer Programming Languages; Computer Simulation; Logic Circuits; Logic Design; Mainframes; Memories; Microcomputers; Minicomputers; Optical Character Recognition; Speech and Pattern Recognition; Storage Devices.

Titles

AMJ Newsletter
Annual Report of Computer Applications, Hydrographic Department, Maritime Safety Agency
Annual Report of the Information Processing Center Tokyo Institute of Technology
Annual Report of Univ. of Tokyo Computer Center
Aoyama Computer Science
Automation
Automation Technique
Automation Technology
Bulletin of the Research Institute for Scientific Measurements, Tohoku University
Center of Large Scale Computer News, Hokkaido University
Computation Center News
Computer
Computer News
Computer Report
Computer Seminar
Computer Weekly
Computer White Paper
Computopia
Data Communication and Processing
Data Processing
Design for Information Processing
Documentation Study
Electronic Parts and Materials
Electronics in Japan
FACOM EDP Papers
FACOM Journal
FACOM News
Gunomonsha
High Precision
Hitac
Home Produced Electronic Computer News
IBM Review
Image Technology
Information
Information, Information Processing, Information Retrieval
Information Processing Research Journal
Instrumentation
Instrumentation
Instrumentation and Automation
Interface
JECC Computer Dynamic Report
JEOL News: Electron Optics Instruments/Application
JIPDEC Journal (Japan Information Processing Development Center)
JIPDEC Report (Japan Information Processing Development Center)
Japan Computer News
Journal of Colloquia on Documentation
Journal of Information Processing
Journal of the Information Processing Society of Japan
Journal of the Institute of Image Electronics Engineers of Japan
Journal of the Instrumentation Control Association, Japan
Journal of the Japan Electric Measuring Instruments Manufacturer's Association

Journal of the Japan Society of Precision Engineering
Journal of the Operations Research Society of Japan
Journal of the Society of Instrument and Control Engineers
Materials of the Monthly Meeting of Information Processing Society of Japan
Micomlife
Micro Computer & Electronics
Microcomputers
NEC Research & Development
Nagoya University, Faculty of Engineering, Automatic Control Laboratory, Research Reports
National Diet Library Automation Project News
News Bulletin of Computer Center, Osaka University
News of Computer Center, University of Tokyo
Official Report of the Computing Center, Electronics Experiment Station
Operations Research as a Management Science
Packaged Information on Computers
Papers from the Annual Meeting on Data Processing of the Institute of Electronics and Communication Engineers of Japan
Papers of Technical Meeting of Applied Magnetics, Institute of Electrical Engineers of Japan
Papers of Technical Meeting of Electronic Devices, Institute of Electrical Engineers of Japan
Preprints of Papers Presented at Institute of Image Electronics, Engineers Research Society Symposium
Preprints of the Institute of Image Electronic Engineers, All-Japan Conference
Preprints of the Symposium of Information Processing Society of Japan
Proceedings of the National Convention for the Study on Information and Documentation
Proceedings of the Symposium of the Information Processing Society of Japan
Papers of the Technical Meeting on Electronic Materials, Institute of Electrical Engineers of Japan
Papers of the Technical Meeting on Information Processing, Institute of Electrical Engineers of Japan
Papers of the Technical Meeting Magnetic Materials, Institute of Electrical Engineers of Japan
Papers of the Technical Meeting on Metallic Materials, Institute of Electrical Engineers of Japan
Papers of the Fluidics Symposium, Society of Instrument and Control Engineers
Report of the Computer Center, Tokyo Institute of Technology
Report of Computer Laboratory, Tanashi Branch of Electrotechnical Laboratory
Report of the Data Processing Center, Kyoto University
Report of the Committee for the Programming, Symposium of the Information Processing Society of Japan
Report of the Programming Symposium
Reports of Research Activities on Computer Science and Technology
Research on Heat Conduction
Research Papers of the Japan Society for Simulation Technology
Research Report Center for Educational Technology, Aichi University of Education
Research Report of the Research Institute of Fundamental Information Science, Kyushu University
Research Reports of Automatic Control Laboratory Faculty of Engineering, Nagoya University
Rite Review
Robot
Soft-Ware Technology
Study-Computer
Symposium on the Use of Cybernetics on the Railway
Systems and Control

Technical Information, Industrial Research Institute, Kochi Prefecture
Technical Papers of the Institute of Electronics and Communication Engineers of Japan
Technical Report (Hokkido University Computing Center)
Telecommunications
Transactions of the Society of Instrument and Control Engineers
White Paper of Computers

Electrical and Electronic Engineering (307 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: AC-DC Power Transmission; Circuit Theory; Communication Theory; Data Transmission Satellite Communication; Electric Power Industry; Electric Power Networks and Systems; Electronic Circuits; Integrated Circuits; LSI; Lasers and Nonlinear Optics; Navigation and Sonar Systems; Microwave Communication; Optical Communication; Radar; Rotating and Linear Electric Machinery; Semiconductor Devices and Materials; Speech and Acoustic Signal Processing; Superconducting Devices; Telecommunication Systems; Television; Ultrasonic Devices and Equipment, VLSI.

Titles

Asian Broadcasting Union Technical Review
AEU: Journal of Asia Electronics Union
Annual Report of Activities of the Nine Electric Power Co.
Annual Report of Electrical Engineering
Annual Report of Technical Research Laboratory of NHK, Broadcasting Science Research Laboratory of NHK
Annual Report of the Chugoku Electric Power Co., Inc.
Annual Report of the Electrical Communication Laboratory
Annual Report of the Electrotechnical Laboratory, Agency of Industrial Science and Technology
Annual Report of the Hokkaido Electric Power Co., Inc.
Annual Report of the Hokuriku Electric Power Co., Inc.
Annual Report of the Kansai Electric Power Co., Inc.
Annual Report of the Kyushu Electric Power Co., Inc.
Annual Report of the Research Lab. of Communication Sciences, Univ. of Electro-Communications
Annual Report of the Shikoku Electric Power Co., Inc.
Annual Report of the Tohoku Electric Power Co., Inc.
Annual Report of the Tokyo Electric Power Co., Inc.
Annual Report on International Telegraph and Telephone
Anritsu Technical Bulletin
Application of Lead Storage Battery
Broadcast Engineering
Bulletin of the Research Institute of Electronics, Shizuoka University
Bulletin of the Electrotechnical Laboratory
Bulletin of the Japan Electric Materials Society
Bulletin of the NHK Broadcasting Science Research Laboratory
Bulletin of the Research Institute of Applied Electricity, Hokkaido University
Bulletin of Tohoku Institute of Technology, Section C: Electrical Communication and Electronics
CQ Ham Radio
CRIEPI (Central Research Institute of Electric Power Industry) Report
CRIEPI (Central Research Institute of Electric Power Industry) Report
Chubu Electric Power News
Circulars of the Electrotechnical Laboratory
Committee Report of Central Research Institute of Electric Power Industry

Communication Industries
Construction of Telecommunication
System
Control Line Technique
Current Survey on Communication
Dainichi-Nippon Cables Review
Dengen News
Densei Technical Journal
Dry Battery
ECL Technical Publication
Electric Machine
Electric Power Civil Engineering
Electrical and Radio News
Electrical Calculation
Electrical Communication Laboratory
Technical Journal
Electrical Communication Laboratory
Technical Meeting Documents
Electrical Construction Engineer
Electrical Construction Engineering
Electrical Cooperative Research
Electrical Daily News
Electrical Devices and Equipments
Electrical Industry News
Electrical Information
Electrical News
Electrical Review
Electrical Technics
Electrical Times
Electricity and Construction
Electricity and Gas
Electrification
Electronic Ceramics
Electronic Engineering
Electronic Parts and Materials
Electronic Science
Electronics
Electronics Digest
Electronics in Japan
Electronics Industry
Electronics Industry in Japan
Electronics Magazine
Electronics News
Electronics Review
Electrophotography
Electrotechnician
Equipment on Telecommunication
Fuji Electric Journal
Fuji Electric Review
Fujikura Technical Report
Fujikura Technical Review
Fujitsu
Fujitsu Scientific & Technical
Journal
Furukawa Electric Review
GS News
GS News Technical Report
General Reports of the Central
Research Institute of Electric
Power Industry
Hitachi Review
Home Electronic Appliance News
ITU and Japan
Illustrated Electric Magazine
Image Technology
Industry and Electricity
Information News of the Electric
Power Development Co., Ltd.
Integration and Assemblying Techniques
International Telecommunications
International Telecommunications
Union Research
Ionics, Ion Science and Technology
Iwatsu Technical Reports
JEE; Journal of Electronic Engineering
JEI; Journal of the Electronics
Industry
JEMIC (Japanese Electric Meters
Inspection Co.) Technical Report
JRC (Japan Radio Co., Ltd.) Review
JTIF (Japan Telecommunication
Industries Federation)
Japan Telecommunications Review
Japanese National Railways.
Electronic Technology Survey
Committee. Materials
Journal of Electronic Industry
Journal of Japan Audio Association
Journal of Japan Electric Assoc.
Journal of Light & Visual Environment
Journal of Nippondenso Technical
Disclosure
Journal of Radio Wave Control Bureau
Journal of the Illuminating
Engineering Institute of Japan
Journal of the Institute of
Electrical Engineers of Japan
Journal of the Institute of Electronics
and Communication Engineers of Japan
Journal of the Institute of Image
Electronics Engineers of Japan
Journal of the Institute of Television
Engineers of Japan

Journal of the Japan Society of Electrical-Machining Engineers
Journal of the Japanese Assoc. of Illumination Engineers
Journal of the Radio Engineering Assoc.
Journal of the Radio Research Lab.
Journal of the Society of Non-Traditional Technology
Journal of the Technical Lab. of Chugoku Electric Power Co., Inc.
Journal of the Technical Lab. of Hokuriku Electric Power Co., Inc.
Journal of the Tokai Rika Co., Ltd.
Jyanaru Journal
KDD Technical Journal
Letters of the General Research Institute, Tohoku Electric Power Ltd.
Matsushita Electric Works Technical Report
Matsushita Electronics
Mitsubishi Denki Lab. News
Mitsubishi Denki Lab. Reports
Mitsubishi Denki Technical Review
Mitsubishi Electric Advance
Mitsubishi Electric Engineer
Monograph Series of the Research Institute of Applied Electricity, Hokkaido University
Monthly Broadcasting Journal
Monthly Journal of the Electrical Communication Laboratory
Monthly Report of the Hokkaido Electric Co., (K.K.)
Monthly: The Electrical Contracting Industry
NEC Magazine
NEC (Nippon Electric Co., Ltd.) News
NEC (Nippon Electric Co., Ltd.) Research & Development
NGK Review. Overseas Edition
NHK Lab. Note
NHK Technical Journal
NHK Technical Monograph
NHK Technical Report
National Connection Record of IElJ
National Technical Report (Matsushita Electric Industry Co., Osaka)
New Nippon Electric Technical Review
News of the Central Research Institute of Electric Power Industry
News of the JEMIC (Japanese Electric Meters Inspection Co.) Instrumentation Circle
Nikkei Electronics
Nippon Signal Technical Journal
Nippon Telegraph and Telephone Public Corp. Telecommunications Research Institute, Development Materials
Nisshin Electric Review
Nitto Technical Report
Ohm
Ohm Bulletin
Osaka Transformer Review
Overseas Electric Power Information
Overseas Telecommunications Journal
Paper of the Tele-Communications Society General All-Japan Meeting
Papers from Symposia Sponsored by the Research Laboratory of Electrical Communication, Tohoku University
Papers from the Annual Meeting on Data Processing of the Institute of Electronics and Communication Engineers of Japan
Papers from the General Meeting of the Institute of Electronics and Communication Engineers of Japan
Papers from the Joint Conference of the Institute of Electrical Engineers of Japan and other Electrical Societies
Papers from Tokyo Chapter Meeting of IEEJ
Papers of Technical Meeting on Applied Electro-Chemistry, IEEJ
Papers of Technical Meeting on Applied Magnetics, IEEJ
Papers of Technical Meeting on Atomic Energy, IEEJ
Papers of Technical Meeting on Electric Cable and Wire, IEEJ
Papers of Technical Meeting on Electric Discharge, IEEJ
Papers of Technical Meeting on Electrical Insulating Materials, IEEJ
Papers of Technical Meeting on Electroacoustics, IEEJ
Papers of Technical Meeting on Electrochemistry and Heating, IEEJ
Papers of Technical Meeting on Electromagnetic Theory, IEEJ

Papers of Technical Meeting on Electronic Circuits, IEEJ
Papers of Technical Meeting on Electronic Devices, IEEJ
Papers of Technical Meeting on Electronic Materials, IEEJ
Papers of Technical Meeting on Electronic Measurements, IEEJ
Papers of Technical Meeting on Industry Applications, IEEJ
Papers of Technical Meeting on Information Processing, IEEJ
Papers of Technical Meeting on Iron and Steel Industry, IEEJ
Papers of Technical Meeting on Laser Engineering, IEEJ
Papers of Technical Meeting on Light Sources and Systems, IEEJ
Papers of Technical Meeting on Magnetic Materials, IEEJ
Papers of Technical Meeting on Metallic Materials, IEEJ
Papers of Technical Meeting on Non-linear Applied Magnetics, IEEJ
Papers of Technical Meeting on Plasma, IEEJ
Papers of Technical Meeting on Power Convertors and Control Equipments, IEEJ
Papers of Technical Meeting on Power Engineering, IEEJ
Papers of Technical Meeting on Railway and Transportation, IEEJ
Papers of Technical Meeting on Research and Education, IEEJ
Papers of Technical Meeting on Rotating Machines, IEEJ
Papers of Technical Meeting on Switching and Protective Devices, IEEJ
Papers of Technical Meeting on System Control, IEEJ
Papers of Technical Meeting on Transformers and Capacitors, IEEJ
Papers of Technical Meeting on Visual Information, IEEJ
Plant Engineering of Kinki Telecommunications
Play Magazine for Audio
Power Resources
Preprints from the Annual Meeting of the Institute of Image Electronics Engineers of Japan
Preprints of Symposium of Society of Image Electronics Engineers
Preprints of the Symposium of the Institute of Television Engineers of Japan
Present Situation and the View
Problems of International Telecommunication
Proceedings of Kyushu Tokai Univ.
Proceedings of the Conference on Image Engineering
Proceedings of the Conference on Solid State Devices
Proceedings of the Institute of Electrostatics Japan
Proceedings of the Symposium on Electrical Insulating Materials
Proceedings of the Symposium on Semiconductors and Integrated Circuits Technology
Production and Electricity
Quarterly Report of the Hokkaido Electric Power Co., Inc.
RIEC Technical Report
Radio TV Technique and Science
Radio Techniques
Radio Wave News
Radio Wave Times
Record of Electrical and Communication Engineering Conversation, Tohoku University
Report of Computer Laboratory, Tanashi Branch of Electrotechnical Laboratory
Report of Denkyoku Central Research Institute, Agricultural Research Institute
Report of Electrical Power Central Research Institute, Electrical Power Technical Research Institute
Report of Electrical Power Central Research Institute, Energy, Environment Technical Research Institute
Report of the Research Department, Kyushu Electric Power Co., Inc.
Report of the Research Lab., Tohoku Electric Power Co., Inc.
Report of the Research Lab. Yasukawa Electric Manufacturing Co. Ltd.
Report of the Technical Lab., Chugoku Electric Power Co., Inc.

Report of the University of Electro-Communications
Report on Practical Television Technology
Report on the Status of Information and Communication Services
Research Annual of Japan Broadcasting Association, Technical Research Institute
Research Bulletin of Electric Power Development Co., Ltd.
Research Development Report, Oki Electric Industry Co., Ltd.
Research Report of High Voltage Power Laboratory
Research Report of the Technical Laboratory, The Hokkaido Electric Power Co., Inc.
Research Reports Institute of Information Science and Technology, Tokyo Electrical Engineering College
Research Reports of Electric Power Development Co., Ltd.
Research Reports of Sendai Technical College
Research Reports (Research Department, The Kyushu Electric Power Co., Inc.)
Researches of the Electrotechnical Laboratory
Review of Electronics and Communications
Review of the Electrical Communication Laboratory
Review of the Radio Research Laboratory
Sanken Technical Report
San'yo Technical Review
Science Report of the Research Institute of Electric and Magnetic Alloys
Semi Annual Technical Report, Shikoku Electric Power Co., Inc.
Semiconductor Technique
Sharp Technical Journal
Shikoku Electric Works Bulletin
Showa Wire and Cable Review
Site Electrotechnics
Sony Corp, Research Center Reports
Stereo Sound High-Technics Series
Storage Battery
Strain News
Sumitomo Electric Technical Review
Sumitomo Electric Technical Review
Summaries of Reports of the Electrotechnical Laboratory, Agency of Industrial Science and Technology
Summary of the Electric Cell Symposium
Survey of Electrical Industry
Survey of Patent Reports Relating to Sub-Miniature Electronic Circuitry
TOA Technical Report
Takaoka Review
Tatsuta Technical Review
Tatsuta Technical Review, Japanese Edition
Technical Bulletin of Nippon Electric Co., Ltd.
Technical Information, Chubu Broadcasting Co.
Technical News, The Nippon Signal Co., Ltd.
Technical Papers of the Institute of Electronics and Communication Engineers of Japan
Technical Report of Nittsuko Ltd.
Technical Report of the Institute of Electrical Engineers of Japan, Pt. 1
Technical Report of the Institute of Electrical Engineers of Japan, Pt. 2
Technical Report of the Institute of Television Engineers of Japan
Technical Review of Nihon Denso
Technology News
Telecommunication Weekly
Telecommunications
Telecommunications Engineering
Telegraph and Telephone
Telegraph and Telephone Business
Telegraph and Telephone Management Monthly
Television News
Television Technics and Electronics
Thermal and Nuclear Power
Toshiba Communication System News
Toshiba Electrical Construction Guide
Toshiba Review
Toyo's Technical Bulletin
Transactions of the Institute of Electrical Engineers of Japan, Pt. A
Transactions of the Institute of Electrical Engineers of Japan, Pt. B

Transactions of the Institute of
  Electrical Engineers of Japan, Pt. C
Transactions of the Institute of
  Electrical Engineers of Japan, Pt. D
Transactions of the Institute of
  Electrical Engineers of Japan, Pt. E
Transactions of the Japan Electron
  Microscope Society
Union List of Papers Presented to the
  Committee on Communication Technology,
  Institute of Electronics and
  Communication Engineers of Japan
Victor AV Communication
White Paper of Communications
Yasukawa News
Yasukawa Review
Yokogawa Technical Report
Yuasa Technical Information

Materials Science (82 titles)

(Includes Plastics, Rubber Technology, Ceramics, Glass and Semiconductor Materials; Metals and Metallurgy are included as a separate section)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Composite Materials; Destructive and Nondestructive Testing; Manufacture of Plastic Products, Micro and Macrostructure of Ceramics, Glass, Plastics and Rubbers; Rheology; Semiconductor Materials (see also Electrical and Electronic Engineering Section).

Titles

Adhesion and Adhesives
Aichi Prefecture Ceramic Technique News
Annual Report of Ceramic Engineering Research Laboratory, Nagoya Institute of Technology
Annual Report, The Asahi Glass Foundation for the Contribution to Industrial Technology
Annual Review (Society of Polymer Science, Japan)
Bulletin of the Kyoto Plastics Association
Cellophane
Cement and Concrete
Ceramics
Clay Science
Communications of the Institute of Solid State Physics
Composite Materials and Design
Composite Materials and Structures
GF (Nippon Glass Fiber Co., Ltd).
Glass Life
Gypsum and Lime
High Density Polyetheline
High Polymers, Japan
Industrial Material News
Industrial Technology Center, Research Reports of the Textile Polymer Materials Research Institute
Japan Plastics
Japan Plastics Age
Japan Plastics (English Edition)
Japan Plastics Journal
Journal of Institute of Materials Science and Engineering, Yokohama National Univ.
Journal of Research of the Onoda Cement Co.
Journal of Society of Materials Science Japan
Journal of the Adhesion Society of Japan
Journal of the Ceramic Society of Japan
Journal of the Clay Science Society of Japan
Journal of the Japan Prestressed Concrete Assoc.
Journal of the Japan Society for Composite Materials
Journal of the Materials Science Society of Japan
Journal of the Society of Polymer Science, Japan
Journal of the Society of Rubber Industry, Japan
Material Science
Natural Rubber
News of Mie Prefectural Ceramic Research Center
NGK Review. Overseas Ed.
Operation Report of Ceramic Research Institute, Aichi Prefecture, Tokoname

Operation Report of Ceramic
Research Institute, Ibaraki
Prefecture
Operation Report of Ceramic
Research Institute, Tochigi
Prefecture
Plan Sheet of Operation,
Technical Ceramic Center,
Aichi Prefecture, Seto
Plastic Molding in Japan
Plastic Times of Japan
Plastics
Plastics (Mitsubishi Plastics
Industries, Ltd.)
Plastics Industry News
(Institute of Polymer
Industry, Inc.)
Plastics Materials
Plastics Scope
Polymer Journal
Polyolefin and Plastics
Proceedings of the Cement Assoc.
of Japan
Proceedings of the Japan Congress
on Materials Research
Quarterly Report of Ready Mixed
Concrete
Refractories
Reinforced Plastics
Report of Ceramic Research
Institute, Fukui
Prefecture
Report of Ceramic Research
Institute, Saga Prefecture
Report of the Kyoto Ceramic
Research Association
Report of the Public Works Material
Laboratory
Report of the Research Laboratory
of Engineering Materials, Tokyo
Institute of Technology
Report of the Research Laboratory of
the Asahi Glass Co., Ltd.
Reports of Ceramic Research Institute,
Aichi Prefecture, Tokoname
Reports of Polymer Science
Reports of the Ehime Prefecture
Ceramic Experiment Station
Reports of the Research Institute
for Strength and Fracture of
Materials, Tohoku Univ.
Reports on Progress in Polymer
Physics in Japan
Research Report of Gifu Prefectural
Ceramic Institute
Research Reports of the Technical
Ceramic Center, Aichi Prefecture,
Seto
Rubber Digest (Monthly Magazine of
Rubber and Plastics)
Rubber Industry
Rubber, Plastics and Cork
Semiconductor Research
Shin'etsu Silicone Review
Synthetic Rubber
Technical Ceramic Center News,
Aichi Prefecture, Seto
Technical Industry Information in
Mie Prefecture Ceramic Series
Technical Report of ISSP, Series A
Technical Report of ISSP, Series B
Transactions of Technical Committee,
Asbestos and Slate Association
Vinyls and Polymers

Mechanical Engineering (90 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: CAD/CAM; Flow of Fluids; Heat Transfer; Heating and Industrial Furnaces; Heating, Ventilating, Air Conditioning and Refrigeration; Hydrodynamics; Hydraulic and Pneumatic Equipment; Machine Tools; Mass Transfer; Mechanisms and Machine Design; Numeric Control Machines; Power Plants (Fossil Fuel, Hydroelectric, Nuclear, Tidal); Prime Movers and Propulsion Devices; Robotics; Thermodynamics; Tribology.

Titles

Air-conditioning and Sanitary Engineering
Annual Report of the Government Mechanical Engineering Laboratory
Annual Report of Yamanashi Prefectural Institute for Machine & Metals Industry
Bearing
Bearing Engineer
Bulletin of JSME (Japan Society of Mechanical Engineers)
Bulletin of Japan Society of Grinding Engineers
Bulletin of Mechanical Engineering Laboratory
Bulletin of the Government Mechanical Engineering Laboratory
Bulletin of the Japan Die Casting Association
Combustion
Crane
Design News
Die and Mold
Factory Management
Fastening & Joining
Fluid Engineering
Fuijikoshi Engineering Review
Gear
Heat Treatment
Heaters
Hydraulics and Pneumatics
Hydraulics and Pneumatics
Hyogo Prefecture Industrial Research Information, Machine and Metal Section
Ibaraki Prefecture Industrial Research Information, Machine and Metal Section
Industrial Fasteners Review
Industrial Machinery
Internal Combustion Engine
Japan Machinist
Journal of Japan Industrial Management Association
Journal of Japan Society of Grinding Engineers
Journal of Japan Society of Lubrication Engineers
Journal of Lift Research Association
Journal of Mechanical Engineering Laboratory
Journal of the Gas Turbine Society of Japan
Journal of the Japan Boiler Association
Journal of the Japan Institute for Screw Threads and Fasteners
Journal of the Japan Machinery Federation
Journal of the Japan Society of Mechanical Engineers
Komatsu Technical Review
Koyo Engineering Journal
Land Internal Combustion Engine
Machinery Damage
Machinery for Remarkable Development
Machinist World Progress of Production Engineering
Mechanical Design

Mechanical Engineering
Mechanical Engineering Annual
Mechanical Engineering Applications
Memoirs of Discussion Meeting of the Japan Society of Mechanical Engineers
Mitsubishi Heavy Industries, Mitsubishi Technical Bulletin
NSK Bearing Journal
New Machine Tools
News of Mechanical Engineering Laboratory
Nihon Spindle Technical Report
Nikkei Mechanical
Overseas Reports on Engineering Industry
Packaging
Packaging Technique
Packs
Papers of Mechanical & Metal Industry Research & Guidance Institute of Hyogo Prefecture
Piping and Process Machinery
Piping Engineering
Press Digest
Proceedings of the Symposium of the Japan Society of Mechanical Engineers
Proceedings of the Symposium of the Japan Society of Mechanical Engineers, Lecture Meeting
Proceedings of the Symposium of the Japanese Association of Refrigeration
Promoting Machine Industry in Japan
Quality Control for the Foremen
Report of the Institute of High Speed Mechanics, Tohoku Univ.
Research on New Machinery Systems in Forestry
Research Papers on Spring
Results of Inspection and Testing
Science of Machinery
Scientific Papers of the RIPAM
Shimazu Review
Statistical Quality Control
Sumitomo Shipbuilding & Machinery
Technical Report of Engineering Development Division, Mitsubishi Atomic Power Co., Ltd.
Technical Report of Mechanical Engineering Laboratory Tokyo
Technical Review-Mitsubishi Heavy Industries
Techniques of Refrigeration and Air-conditioning
Technocrat
Tokico Review
Tool Engineer
Toyota Technical Review
Transaction of Association of Mechanical Technology
Transactions of the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan
Turbomachinery
Valqua Review

Metallurgy (53 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Corrosion; Electrometallurgy; Forging and Forming; Foundry Practice; Heat Treatment; Hydrometallurgy; Metal Plating; Metal Refining; Metallography, Metallurgy; Metallurgical Furnaces; Powder Metallurgy; Pyrometallurgy and other Processing Techniques; Rolling; Welding and Bonding.

Titles

Aluminum
Aluminum Age
Bulletin of the Japan Iron and Steel Federation
Corrosion Engineering
Current Review on New Metals
Ferro Alloy
Industrial Heating
Industrial Rare Metals
Iron and Steel
Iron and Steel Industry
Journal of Japan Institute of Light Metals
Journal of Light Metal Welding and Construction
Journal of the Aluminum Research Association
Journal of the Iron and Steel Institute of Japan
Journal of the Japan Institute of Metals
Journal of the Japan Society for Technology of Plasticity
Journal of the Japan Society of Newer Metals
Journal of the Japan Society of Powder and Powder Metallurgy
Journal of the Japan Welding Society
Kawasaki Steel Technical Report
Kobe Steel Engineering Reports
Lead and Zinc
Machine and Metals News
Metals
Metals Journal
Mitsubishi Steel Manufacturing Technical Review
Newer Metal Industry
News of Showa Aluminum Co.
Nippon Kokan Technical Report, Overseas
Nippon Steel Technical Report
Nippon Steel Technical Report, Japanese Edition
Proceedings of the Japan National Symposium on Strength, Fracture and Fatigue
Report of Central Research Laboratory, Sumitomo Metal and Mining Co., Ltd.
Report of National Research Institute for Metals
Report of the Castings Research Laboratory
Reviews of Welding
Stainless
Steel Today and Tomorrow
Sumitomo Light Metal Technical Reports
Sumitomo Metals
Sumitomo Search
Summary Report of the Conference, the Japan Welding Society
Technical Report of Sumitomo Special Metals
Transactions of Iron and Steel Institute of Japan
Transactions of JWRI
Transactions of the Castings Research Laboratory
Transactions of the Japan Institute of Metals
Transactions of the Japan Welding Society
Transactions of the National Research Institute for Metals (Tokyo)
Welding Engineer
Welding News

Welding Technique
Wire Rod & Its Products :

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Mines and Mining (8 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Coal; Gas Fuels; Liquid Fuel Engineering; Mineral Dressing; Mining Methods and Operations; Sampling and Valuation; Solid Fuels.

Titles

Colliery Engineering
Journal of Japan Institute of Aggregate Technology
Journal of Mining and Metallurgical Institute of Japan
Mining Geology, Journal of the Society of Mining Geologists of Japan
Mitsubishi Coal Mining Technology
Monthly News, the Coal Mining Research Center, Japan
Rock Drill
Seika Technical Report

Photo-Optical Technology (9 titles)

(For Lasers, Nonlinear Optics, Holography, Fiber Optics, see the section on Electrical and Electronic Engineering)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Photographic Equipment; Photographic Instrumentation and Processing; Photoreproduction Techniques.

Titles

Applied Physics
Electrophotography
Instrumentation
Japanese Journal of Optics
Journal of the Society of Photographic
   Science of Japan
Optical Engineering Contact
Photographic Industries
Photography in Japan
Scientific Publications of the Fuji
   Photo Film Co., Ltd.

Shipbuilding (17 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Naval Architecture; Ship Auxiliary Equipment; Ship Design; Ship Structural Components; Shipyards.

Titles

Bulletin of the Shipbuilding Research
   Association of Japan
Bulletin of the Society of Naval
   Architects of Japan
Dredger
Hitachi Zosen Technical Review
IHI Engineering Review
Japan Shipbuilding and Marine Engineering
Journal of the Marine Engineering Society
   in Japan
Journal of the Society of Naval Architects
   of Japan
Marine Engineer
Marine Engineering
Marine Machinery Development
Mitsui Technical Review
Naval Architecture and Ocean Engineering
Papers of Ship Research Institute
Shipbuilders' News
Shipbuilding & Engineering
Transactions of the West-Japan Society of
   Naval Architects

Transdisciplinary (56 titles)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Applied Mathematics; Chemistry; Engineering; Geophysics; Medicine; Nuclear Science and Technology, Physics; Statistics.

Titles

Annual Reports of the Research Reactor Institute, Kyoto Univ.
Bulletin of Mathematical Statistics
Bulletin of Science and Engineering Research Laboratory, Waseda Univ.
Bulletin of the College of Engineering, Hosei Univ.
Bulletin of the Disaster Prevention Research Institute
Bulletin of the Institute of Atomic Energy, Kyoto Univ.
Bulletin of the Univ. of Osaka Prefecture, Series A, Engineering and Natural Sciences
Engineering Industries of Japan
Engineers
FAPIG
Hoechst Immuno-Review
Invention
Japan Industrial & Technological Bulletin
Japanese Journal of Applied Physics
Japanese Journal of Thoracic Diseases
Journal of Nuclear Science and Technology
Journal of Physics of the Earth
Journal of the Atomic Energy Society of Japan
Journal of the Faculty of Engineering, Univ. of Tokyo, Series B
Journal of the Faculty of Engineering, Univ. of Tokyo, Series A, Annual Report
Journal of the Japan Statistical Society
Journal of the Physical Society of Japan
Keio Engineering Reports
Mathematics
Memoirs of Chubu Institute of Technology, Series A
Memoirs of Faculty of Engineering, Keio Univ.
Memoirs of Faculty of Technology, Tokyo Metropolitan Univ.
Memoirs of the Faculty of Engineering, Hokkaido Univ., Sapporo, Japan
Memoirs of the Faculty of Engineering, Kobe Univ.
Memoirs of the Faculty of Engineering, Kyoto Univ.
Memoirs of the Faculty of Engineering, Kyushu Univ.
Memoirs of the Faculty of Engineering, Nagoya Univ.
Memoirs of the Faculty of Technology, Kanazawa Univ.
Memoirs of the Hokkaido Institute of Technology
Memoirs of the National Defense Academy, Japan, Mathematics, Physics, Chemistry and Engineering
Memoirs of the the Schools of Science and Engineering, Waseda Univ.
Natural Disaster Science
Proceedings of Theoretical Physics
Report of the National Research Institute for Pollution and Resources
Reports of Statistical Application Research
Reports of the Institute of Industrial Science, Univ. of Tokyo
Reports of the Institute of Physical and Chemical Research

Research Reports of the Faculty of Engineering, Kinki Univ.
Science Reports of the Research Institute, Tohoku Univ. Series A, Physics, Chemistry and Metallurgy
Scientific Bulletin
Scientific Monograph (Series) ONRT
Scientific Papers of the Institute of Physical and Chemical Research (Japan)
Statistics
Technical Highlights
Technical Reports of the Institute of Atomic Energy, Kyoto Univ.
Technology Reports of the Iwate Univ.
Technology Reports of the Kansai Univ.
Technology Reports of the Osaka Univ.
Technology Reports of the Tohoku Univ., Sendai, Japan
White Paper of Science and Technology in Japan

Transportation (84 titles)

(Titles dealing with Shipbuilding are included as a separate section)

The titles included in this section contain, but are not limited to, technical information in the following general areas: Automotive Engineering; Highway, Rail, Air and Waterway Transportation; Marine Engineering; Railroad Rolling Stocks; Technology of New Transportation Systems, Transportation Safety.

Titles

Annual of Railroad Technological Institute
Annual Report of Japan Railway Civil Engineering Association
Annual Report of Roads
Annual Report of the Japan Association of Rolling Stock Industry
Auto Mechanic
Auto Times
Automobile and Maintenance
Automobile Engineering
Automobile Engineers' News
Automobile Industry
Automobile Industry
Automobile Journal
Automobile Parts Industry
Automobile Parts Industry in Japan
Automobile Production Technology
Electric Railways
Express News
Expressways and Automobiles
Industrial Vehicle and Transportation Machinery
Industrial Vehicles
Isuzu Automobile News
Isuzu Technical Journal
JARI (Japan Automobile Research Institute, Inc.) Technical Memorandum
JARI (Japan Automobile Research Institute, Inc.) Technical Report
JARI (Japan Automotive Research Institute) Technical Research
Japan Motor Industry/JMI
Japanese Railway Engineering
Journal of Distribution
Journal of Japan Accident Medical Association
Journal of Japan Automobile Research Institute Inc.
Maintenance of Way
Marine Transportation Research
Memoirs of the Automotive College of Hokkaido
Monorail
Monthly Journal of the Auto Tire Progress
Morioka Construction Bureau, JNR News
Motor Age
Motor Fan
Motor Vehicle
Navigation, Journal of Nautical Society of Japan
News of Gifu Construction Bureau, JNR
News of Tokyo 2nd Construction Bureau, JNR
Nissan Diesel Review
Nissan Technical Review
Overseas Information of Automotive Industry
Pavement
Permanent Way
Preprints of the Symposium of the Railroad Technological Institute
Preprints of the Symposium of the Society of Automobile Engineers of Japan

Proceedings of Annual Meeting of Chubu
Quarterly Reports-Railway Technical
Research Institute (Japan)
Railway Business
Railway Civil Engineering
Railway Engineering Abstracts
Railway Technical Research Report
Record of Works, Tokyo 1st Construction
Bureau, Japanese National Railways
Records on Railway Maintenance
Report of Transportation Technical
Research Institute
Road and Cement
Road Construction
Rolling Stock Engineering
Rolling Stock Industry
Signaling
Subway
Symposium on the Use of Cybernetics
on the Railway
Technical Information, Japan Bicycle
Promotion Institute
Technical Report of the Railway Technical
Research Institute, Kinki Nihon
Railways
Technical Report of Toyota RD Center
Technical Review, Hino Motors Ltd.
Tokyu Sharyo Technical Review
Toyota Auto Body Engineering
Toyota Engineering
Traffic Engineering
Transactions of the Society of
Automobile Engineers of Japan, Inc.
Journal of Motor Cars
Journal of Railway Engineering Research
Journal of the Japan Maritime Research
Institute
Journal of the Nakanihon Automotive
Junior College
Journal of the Nautical Society of Japan
Journal of the Society of Automotive
Engineers of Japan, Inc.
Journal of Tokyo Construction Office, JNR
Kansai Roads Research Society Report
Laboratory Report of Japan Highway
Public Corp.
Machine Tools for Automobiles

Mr. WALGREN. Thank you very much, Mr. Landau.

That is interesting and specific, and we will come back in a bit. But let's go to Mr. Polsky then, and for his testimony.

Mr. POLSKY. Mr. Chairman, members, staff:

My associate Dr. Tsukahira is a retired foreign service officer, U.S. Foreign Service, and can do technical translations.

This country can no longer afford the arrogance of indifference to scientific and technical developments in other nations, now serious competitors to our products in the arena of domestic and international trade.

Previous testimony and a series of hearings conducted by this subcommittee has been of compelling interest to me. However, as I appear here, I have the sense that once again those gathered and whose testimony will again be published may be destined to preach to the converted, ourselves, and our colleagues and associates.

In the course of preparing for this testimony, I telephoned the White House Office of Science and Technology Policy. A fundamental question regarding the essential subject of these hearings: how to develop a national policy and implement a program for systematic and ongoing collection of intelligence data from open sources concerning the current state of Japan's leading edge, information and technological developments, the question is: Who has the authority to coordinate such a program among a variety of competing interests within our government and within the private sector?

Vital national imperatives dictate the necessity for the highest level of authority to set policy for implementation of the many valuable recommendations which are coming out of these hearings.

The genuinely honest and truly reciprocal exchange of scientific and technological advances among nations seems essential for a world order which must be aspired to, even by the most skeptical, in this dangerously contentious nuclear era.

There is a particular type of legislation which the Congress could pass. Our antitrust legislation and enforcement procedures, fair trade laws, and other regulations, in my view, seriously hamper the best of our high-tech companies who are well aware that the national interest, as well as responsibility to their own shareholders, dictate collaboration with competitors, and the ending of counterproductive adversarial relations with numerous governmental agencies.

Relaxation of existing laws and enforcement procedures, and eventual congressional alteration of the same, requires caution, great skill, and an extraordinary ability to weigh among a variety of perhaps contradictory public interests. No one in this room wants to see a sanctioning of invidious types of collusion.

But it should be apparent in the America of the 1980's that the adversarial relations among business, government, labor, the public, and the press must be significantly tempered to the realities of an increasingly competitive international economic environment and the equally harsh realities of encroachment of foreign originated products and technology into our domestic economy with terrible effect on some of our basic industries.

To compete more effectively against these new international challenges to America's past economic supremacy, we must not scapegoat a country like Japan. We must become tougher in our trade negotiations, demonstrating a hard, credible determination to really exchange tit for tat; we must become better competitors by responding with America's traditional genius to foreign competition; we must coordinate the disparate, wasteful, parochial, and frequently duplicative work of numerous Government agencies which translate, at great effort and expense, Japanese technical and scientific articles, conference proceedings, and other publicly available documents.

Some of the firms most successful in penetrating Japan's research and development sector, collecting public information on a selected basis, and correctly and usefully analyzing it, would not openly testify to such successes no matter how fairly won.

If Americans are quick to cry foul against Japan, the Japanese show an equal predeliction to call foul against us. Some American companies do show a systematic brilliance in legally penetrating the obstacles of the Japanese language and of a society that is selectively closed in important areas to foreigners as a matter of historical, racial and cultural preferences.

Such companies, privately, may justly bemoan the high cost of collection, abstracting, translation, and then following a particular research trail.

The same executives from a woefully few American companies also hunger for the contents of pockets throughout the U.S. Government, particularly in the intelligence community, where valuable translations already exist of important Japanese scientific and technical material.

I do not know what these intelligence agencies translate from the Japanese, but I will take an educated guess that perhaps 75 percent of such materials have a secret or higher classification only because they were collected and translated by a clandestine agency, not because the material was obtained in covert, illegal fashion, or it is not in the public domain in Japan.

In fairness to all the Government agencies concerned, translation of Japanese documents can tread very close to copyright violations, particularly if the end product is widely disseminated and/or sold. Given a high enough priority, there must be some avenue by which the United States and Japanese governments could agree to resolve or bypass the problem in the higher interests of both nations.

A more recent development has been the decision of the American Electronics Association to open an office in Tokyo precisely, aparently, for the purposes of surveying Japanese scientific and technical publications and other documents; preparing technical translations of other documents; preparing English language abstracts based on expressed interests of members; and doing complete translations and other research when required.

This seems a large, expensive, and complex undertaking, but most worthwhile. It remains to be seen whether the Japanese Government will attempt to put administrative barriers in the way of this American enterprise in Japan.

Whatever the published differences between United States and Japan on these issues, unquestionably there has been substantially increased cooperation in the scientific and technical aspects of such things as military electronics.

With an estimated 10,000 Japanese language science and technology publications, the job of collection, reading, assessment, English-language abstracting, full translation leading to further specialized research in a particular area, and evaluation of what the information means competitively today and what it might mean 5 or 10 years hence, seems overwhelming even given an increased degree of interest, coordination and collaboration than presently exists in this country.

Yet in a changed, now fiercely competitive international economic environment in which U.S. science and technology can no longer automatically be assumed to be the best, we have no choice but to master these problems, and Japan is the best place to begin.

Thank you.

[The prepared statement of Mr. Polsky follows:]

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TESTIMONY OF ANTHONY POLSKY, PRESIDENT, CATHAY COUNSELLORS GROUP, INC. BEFORE THE U.S. HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, AT HEARINGS IN WASHINGTON, D.C., MARCH 6 AND 7, 1984.

This country can no longer afford the arrogance of indifference to scientific and technical developments in other nations now serious competitors to our products in the arena of domestic and international trade. Previous testimony at a series of Hearings conducted by this Subcommittee has been of compelling interest to me professionally and intellectually, as it addresses a subject which should be of vital national concern. However, as I appear here, no matter how willingly, I have the sense that once again those gathered and whose testimony will again be published, are destined to preach to the converted -- ourselves, and our colleagues and associates.

In the course of preparing for this testimony, I telephoned The White House Office of Science and Technology Policy (OSTP). A fundamental question regarding the essential subject of these hearings -- how to develop a national policy and implement a program for systematic and ongoing collection of intelligence data from open sources concerning the current state of Japan's "leading edge" scientific and technological developments -- is: Who has the authority to coordinate such a program among a variety of competing interests within our Government and within the private sector? The fairly senior official with whom I spoke at OSTP not only was unaware of this Subcommittee's activities, he also expended some effort arguing why some place other than The White House should take the lead. The OSTP may not be the right place, but vital national imperatives which no longer can be avoided or equivocated, dictate the necessity for the highest level authority to set policy for implementation of the many valuable recommendations which are coming out of these hearings.

Unfortunately, in my view, even the legislation which might emanate from this Subcommittee or from other parts of the Congress, will be insufficient in itself to resolve a host of complex problems. But, the Subcommittee is performing an invaluable service to the nation just by having these hearings. I have been a journalist for almost 25 years before "falling from grace" and founding a consulting company. If it were still within my power, I would see that the testimony called by the Subcommittee on Science, Research and Technology, was continously in the headlines not only in this country but in Japan and throughout the world. The genuinely honest and truly reciprocal exchange of scientific and technological advances among nations seems essential for a world order which must be aspired to, even by the most skeptical, in this dangerously contentious nuclear era.

Apart from this series of Hearings, there is a particular type of legislation which the Congress, not necessarily this Subcommittee, could pass. We no longer have the sort of economy, or position in the world, which existed at the time of President Teddy Roosevelt's "Trust Busting". I suppose as a former investigative reporter and business journalist, I continue to have a higher degree of skepticism about the efficient performance, and ethics, of some of our largest corporations -- indeed, smaller ones. Nonetheless, our antitrust legislation and enforcement procedures, fair trade laws and other regulations, in my view, seriously hamper the best of our high tech companies who are well aware that the national interest as well as responsibility to their own shareholders dictate collaboration with "competitors", and the ending of counterproductive adversarial relations with numerous governmental agencies.

Relaxation of existing laws and enforcement procedures, and eventual Congressional alteration of the same, requires caution, great skill and an extraordinary ability to weigh among a variety of perhaps contradictory public interests. No one in this room wants to see a sanctioning of invidious types of collusion. But it should be apparent in the America of the 1980s that the adversarial relations among business, government, labor, the public and the press must be significantly tempered to the realities of an increasingly competitive international economic environment and the equally harsh realities of encroachment of foreign originated products and technology into our domestic economy with terrible effect on some of our basic industries. Our national self-interest, including jobs and security for millions of Americans, demands this. Although Japan's scientific and technological advances are partly the subject of this series of hearings, other nations also increasingly compete with us and cause harm to sectors of our economy and many of our workers.

To compete more effectively against these new international challenges to America's past economic supremacy, we must not "scapegoat" a country like Japan. We must become tougher in our trade negotiations, demonstrating a hard, credible determination to really exchange "tit for tat"; we must become better competitors by responding with America's traditional genius to foreign competition; we must coordinate the disparate, wasteful, parochial, and frequently duplicative work of numerous government agencies which translate, at great effort and expense, Japanese technical and scientific articles, conference proceedings and other publicly available documents; we must alter the relevant laws to permit, very cautiously, new types of collaboration among American high technology firms, and, in turn, between them and our government; and finally and imperatively we must recognize that all of the above is a significant and necessary precondition to restoration of our national economic health and wealth in a world business environment now permanently altered from the halcyon quarter century following World War II when American science, technology and business entrepreneurship reigned supreme and mostly even unchallenged.

I do not know how to wake slothful, ignorant, impatient, parochial and short-sighted American corporate executives to the above necessities and realities. Their lives and their businesses are governed by the 12-month cycle and ruled by stock analysts, the vagaries of Wall Street, and the petulance of profit-oriented shareholders who do not understand the vaster benefits of a long-range view. Some of these businessmen gave nearly for no compensation important technology to Japanese firms in the 1950s and 1960s. True, it was national policy to assist in Japan's economic reconstruction following World War II. But Japan received some valuable technologies just because Americans thought development too troublesome themselves. Some of this technology has come back to America in the form of transistor radios, color televisions, and video tape recorders, and even automobiles.

Those attending these hearings or monitoring what is published from them obviously do not fall into the slothful or slumbering category. They well know Japan's competitive threat and the present inadequacies in our own system for meeting it. Some of the firms most successful in penetrating Japan's research and development sector, collecting public information on a selective basis, and correctly and usefully analyzing it, would not openly testify to such successes no matter how fairly won. If Americans are quick to cry "foul" against Japan; the Japanese show an equal predeliction to call "foul" against us. Some American companies do show a systematic brilliance in legally penetrating the obstacles of the Japanese language and of a society that is selectively closed in important areas to foreigners as a matter of historical, racial and cultural preference. However the method of this work is treated as highly sensitive as are the results even though the information is collected from "open" sources.

Such companies, and there are only a few, are not likely to reveal the secrets of their successes in Japan at such a public hearing as this. However, privately, many justly bemoan the high cost of collection, abstracting, translation, then following a particular research trail. They argue for greater collaboration with other American companies interested in the same things, and rail at company lawyers, who are rightly cautious of running afoul of current American law and who refuse permission for such collaborative efforts. The same executives from a woefully few American companies also hunger for the contents of pockets throughout the U.S. Government, particularly in the Intelligence Community, where valuable translations already exist of important Japanese scientific and technical material.

Perhaps it is worthwhile listing here some of the various places within our government where translations from Japanese-language scientific and technical documents are done, or are made available to the public for in some cases a fee. I also will list some resource centers in the academic world and in the private sector, although neither list should in any way be taken as comprehensive. The Joint Publications Research Service of Arlington, Virginia, which has some sort of CIA affiliation, publishes translations and a Japan report which can be purchased; the National Technical Information Service of the Commerce Department and the Foreign Broadcast Information Service (FBIS), an "overt" arm of the CIA, both of which will have representatives testifying at these hearings, also has a good deal of useful material available to those individuals and corporations which maintain accounts, or subscribe; the Defense Documentation Center, Cameron Station, Virginia; the Office of the Special Trade Representative; the U.S. International Trade Commission; the U.S. Information Agency; the State Department's Japan Desk as well as the Bureau of Oceans, International Environmental and Scientific Affairs among other sections; the U.S. Bureau of Standards; the National Science Foundation; the National Academy of Sciences; the U.S. Justice Department (in the antitrust division among other places); The White House Office of Science and Technology Policy; Library of Congress; the Congressional Office of Technology Assessment; the Smithsonian Institution; and the National Aeronautics and Space Administration are just some of the major agencies and institutions which have Japanese language capabilities in the science and technology field.

By no means not least in Japanese language translation capability is the "Intelligence Community" which includes the Central Intelligence Agency (CIA); the Defense Intelligence Agency (DIA); the National Security Agency

(NSA) and a host of other clandestine and quasi-clandestine bodies. I do not know what these intelligence agencies translate from the Japanese, but I will take an educated guess that perhaps 75 percent of such materials have a "secret" or higher classification only because they were collected and translated by a clandestine agency, not because the material was obtained in covert, illegal fashion or is not in the public domain in Japan. This is an unknown, unmeasured treasure trove of valuable technical and scientific information from Japan which could valuably serve more than one type of analysis, more than one sort of "client". These days I do not know who has the power, or the inclination to prise such information from the "Intelligence Community". But it surely could be done without hazard to our real secrets and the interests of our real national security. We cannot afford hoarding or parochialism regarding information important to our national economic well-being in the face of serious competition from countries such as Japan.

In fairness to all the government agencies concerned, translation of Japanese documents can tread very close to Copyright violations particularly if the end product is widely disseminated and/or sold. For example, the American Embassy in Tokyo produces on a daily, timely basis, translations of all major articles from Japan's daily, weekly and monthly press as well as important other journals. During my tenure as a correspondent in Asia, this was invaluable reference material. However, distribution essentially is limited within the Embassy, to resident American correspondents and a few other selected individuals in Tokyo. A very few copies are sent to the State Department, and at least one of each issue apparently is available at the Library of Congress. There was some discussion of turning this considerable and expensive translation operation into a commercial endeavor, and selling subscriptions. But this fell afoul of Copyright restrictions. Given a high enough priority, there must be some avenue by which the U.S. and Japanese governments could agree to resolve or bypass the problem in the higher interests of both nations.

Numerous academic institutions across the country have varying degrees of expertise in translation of important Japanese documents in the scientific and technical field. Some have particular programs with this emphasis. There is an important program in this field run at the Massachusetts Institute of Technology. This MIT program held a workshop in January 1983 entitled "Japanese Scientific and Technological Information in the United States", published in March 1983 and available from NTIS. The University of Chicago's John Crerar Library apparently sponsors a National

Translation Services which, within the academic world, tries to disseminate translations from the Japanese in a fashion similar to NTIS or the Joint Publications Research Service. Unquestionably there are other noteworthy academic efforts along the above lines, but to the best of my knowledge, there has been no systematic effort at collating these academic resources for Japanese translation and dissemination in one place or one publication.

Relatively recently, there have been some encouraging developments which promise to at least point the way out of a very serious dilemma for Americans with respect to Japanese competition, whether actual or potential, in the scientific and technical field. The Microelectronics and Commputer Corporation of Austin, Texas, headed by Admiral Bobby R. Inman, represents a collaborative effort by several major American companies to develop the so-called "Fifth Generation Computer". MCC is a cautiously permitted example of U.S. Government forbearance (with respect to antitrust and other laws). It also represents a gratifying acknowlegement and example from American companies that certain types of research and development are of such high national priority and tremendous cost that a collaborative project is the only feasible means of accomplishing the objectives.

A more recent development has been the decision of the American Electronics Association to open an office in Tokyo precisely for the purposes of surveying Japanese scientific and technical publications and other documents; preparing English language abstracts based on expressed interests of members; and doing complete translations and other research when required. This seems a large, expensive and complex undertaking, but most worthwhile. It remains to be seen whether the Japanese government will attempt to put "administrative barriers" in the way of this American enterprise in Japan. This new office is being supported in part by the U.S. Commerce Department which also has established a "U.S.-Japan High Technology Working Group". The latter is involved in frank, increasingly wideranging discussions with Japan's powerful Ministry of Trade and Industry (MITI) regarding relaxation of barriers to technology transfer between the two countries on a genuinely reciprocal basis.

Whatever the published differences between U.S. and Japan on these issues, unquestionably there has been substantially increased cooperation in the scientific and technical aspects of such things as military electronics. Neither country talks much about this, but the Japanese recently have had some unpleasant scares and threats from the Russians. This plus the pro-defense attitude of the

Nakasone Government has made military technology transfer easier and more frequent, although still a very sensitive, and thus very guarded subject.

With an estimated 10,000 Japanese-language science and technology publications, plus documents from numerous conferences and proceedings, the job of collection, reading, assessment, English-language abstracting, full translation leading to further specialized research in a particular area, and evaluation of what the information means competitively today and what it might mean five or ten years hence, seems overwhelming even given an increased degree of interest, coordination and collaboration than presently exists in this country. Yet in a changed, now fiercely competitive international economic environment in which U.S. science and technology can no longer automatically be assumed to "be the best", we have no choice but to master these problems, and Japan is the best place to begin.

Anthony Polsky, Biography,
Testimony before House Science and
Technology Committee, Washington, D.C.,
March 6 and 7, 1984.

CATHAY
COUNSELLORS
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Anthony Polsky
President

ANTHONY POLSKY, President and founder of CATHAY COUNSELLORS GROUP, INC. (1981). A journalist and foreign correspondent for almost 25 years, Polsky has worked and lived in Hongkong, Singapore, Tokyo, New York, London and Washington. He lived in Asia during the 1960s and early seventies, originally as a correspondent for **The New York Herald Tribune**; then, as Deputy Editor of **The Far Eastern Economic Review** (Hongkong) (in part, during China's Cultural Revolution); correspondent for **The New York Times**, based in Singapore. During that time, he also regularly contributed to **The London Financial Times**; **The Economist**; **The Bulletin** (Sydney); **Nihon Keizai Shimbun** (Tokyo); **Business Week** and other McGraw-Hill publications. On returning from overseas, once again to New York, Polsky became North American Financial Editor for **Reuters** news agency. He continued as regular contributor to such publications as **The Washington Post**, **The Economist**, **The Financial Times** and a variety of magazines, newspapers and academic publications throughout the world.

Polsky was recipient of a Ford Foundation Fellowship in Advanced International Reporting at the Graduate School of Journalism, Columbia University (1971-72); a Fulbright Fellowship special economics and journalism research grant to Japan (1973-74). He did undergraduate work in history, political science and anthropology at Reed College (Portland, Oregon); and graduate work in the same fields at The New School for Social Research and Columbia University. Polsky is a member of a variety of professional and international organizations including the National Committee on U.S.-China Relations; The National Council for U.S.-China Trade; The Asia Society; International House of Japan; Japan Society of New York. He works from an office in his home in Beaverton, Oregon (a Portland suburb). CCG has offices in Washington, D.C. His international consulting company is opening affiliate offices in Houston, Tokyo and Hongkong this year.

Mr. Polsky has been assisted in preparation of this testimony by a key associate, Professor Toshio George Tsukahira of Bethesda, Maryland. Prof. Tsukahira is a retired U.S. Foreign Service officer who served several tours of duty at the American Embassy in Japan; received his Ph.D. from Harvard; has been a lecturer in the Woodrow Wilson School of Public Affairs Princeton University; continues as a consultant to the State Department; and is the author of several scholarly works on Japan, as well as his work for CCG and its clients.

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Mr. **Walgren**. Thank you very much, Mr. Polsky.

That's good testimony. And you know there are certainly stirrings in the Congress to try to encourage some of the cooperative efforts and the relaxation of the adversarial relations that our economy is mired in; there's no question about that.

This committee has been active in that area, and in fact passed a bill in an attempt to make it clear that the antitrust laws should not restrict joint efforts in basic research and the like. And we hope that we are inclined in the right direction in that area.

I wanted to ask Mr. Landau this question of demand for the information. You have told us of your experience in seeking support for an effort in that area, finding some support but not finding the broad-based interests that would make it clearly economically feasible.

Do you believe the Government should have some role in at least making some of this information possible to gather?

Mr. **Landau**. Yes, I definitely believe—I think it's an area of national importance, and the Government should provide some support.

Mr. **Walgren**. Um-hum.

Mr. **Landau**. Perhaps seed money, in one form or another. I think we have the resources in this Nation, not only my own organization but other services who could do it.

But because of the expense and risks involved, I suspect that many are wary of attempting this.

Mr. **Walgren**. And you found no response in the White House, in any event, when you called?

Mr. **Landau**. No, we found a great deal of moral support, but not very much in the way of material support. Having an interest in parallels, look at Japan where they have the Japan Information Center for Science and Technology, JICST, which is Government supported and which is playing a very important role in covering the literature, not only of Japan, but of the world, and translating it into Japanese.

When I was in Japan in November, one of the questions I asked there was why the use of our services in Japan had been falling off so rapidly. And the answer that our Japanese colleagues gave us is that JICST is now covering the same information that we do, but in Japanese. So there was no need for the Japanese engineering community and scientific community to subscribe to our services anymore, because they could get it at a lower price in their own language with Government support.

Mr. **Walgren**. With Government support?

Mr. **Landau**. Yes, the Government is subsidizing theirs.

Mr. **Walgren**. The price of this service as it is anticipated, $45,000, and $24,000, that is per subscriber, so that would be a major investment on the part——

Mr. **Landau**. Yes.

Mr. **Walgren** [continuing]. Of that——

Mr. **Landau**. I should add that would be for a 1-year subscription per subscriber.

Mr. **Walgren**. All right.

Mr. **Landau**. That would be our attempt to get seed money in as a joint venture.

Mr. **Walgren**. Um-hum.

Mr. **Landau**. After that point we would hope that the development cost would be provided, and then we could offer it on a much broader scale at a much lower cost.

Mr. **Walgren**. Have you ever attempted any matching proposal with a relevant Government agency? I don't know whether they would be prepared to match private funds through the NTIS. Of course, I'd suspect then there is a problem in that everyone has access to Government funding, and you really need an angel that would allow everyone access to the information, or be interested in everyone having access to the information.

Mr. **Landau**. Due to the first part, no, we hadn't attempted any joint funding; to be honest, we weren't sure which agency to address on that.

Mr. **Walgren**. Mr. Polsky, you indicate that some companies seem to have some magic in their ability to access, and yet they are not particularly anxious to share that information.

Mr. **Polsky**. Well, there, I was sworn to secrecy. I mean, when some of them told me about their monitoring activities in Japan which, by the way, are quite legal, I mean, I didn't have any discussions about anything that was not legal. But it's quite true in a lot of international matters that those people who are most successful don't usually advertise the fact. And I was quite encouraged. Of course, a couple of the companies that I talked to are very major electronic or high-tech firms in this country. But the kind of intellectual and philosophical underpinnings by which they collect scientific information is quite impressive. I mean that a lot of times just thinking doesn't get you points in an American company.

I mean, you sit there with a pile of documents and you have read this stuff, and you spend a couple hours looking out the window, and just, you know, thinking about what you've read. Well, that hasn't been the American way as much as I think it should have been. And some of the people that I talked to do exactly that.

And they go to Japan, they visit, they have friends there, they have—sometimes they employ Japanese consultants; and they do a lot of thinking, and not only about present, you know, immediate competitive threats, and trends, in Japan, but long-term thinking about it. This is quite a—in effect, I mean, our overall intelligence-gathering effort in this country at the governmental level, I think, personally, has gotten too technological in orientation. I mean, there's too much satellites, and electronic intelligence, and stuff. And I think really the best kind of intelligence sometimes is just this business of thinking about things after you've read about them. And, of course, I have a bias in that direction because of my own background.

But some of the companies that I talked to, I believe have even been approached about testifying in front of this subcommittee; not necessarily any particular individuals. There seemed a certain reluctance because they don't want to—the Japanese are very quick to start talking about spying and stuff like that—and they don't want to get involved in that.

So I think that they would be willing to share with one another. But as I said, in one particular case, an individual I talked to was bemoaning the terribly high expense of, you know, having documents translated and he said that every time he's had an urge to talk to one of his colleagues in another major high-tech company about this and; you know, just get together and think things out, his company lawyers say no, no. You know, you can hardly talk to or have lunch with anybody anymore under some of the, you know, rules of the Government. Does that——

Mr. **Walgren**. Is there any way to distinguish between some of the kinds of things that a private company would be most interested in, as I gather that's where they would be most restrictive in their sharing. I suppose it comes down to commercial levels of interest as opposed to basic research.

When you look at these journals that are available, is there a division there where, at least on our side, we should be much more willing to freely share a certain level of information that might be very useful for our economy and our scientific establishment?

Mr. **Polsky**. I think that—if the meaning of your question is can we—American companies—share as long as we are not letting any competitors know about the product that's coming out next spring—I think the answer is, "Yes." But the nature of your question as I understand it, has to do with both science and also the law, and marketing. How could you create a framework either with the antitrust division or any other regulatory, or enforcement agencies, to permit companies to share this sort of a basic scientific research? I think they would be willing to do it, but I think there would have to be some real thinking done about how they could do it in the fashion that would: one, not give away a company's immediate marketing secrets and; two, not violate any laws of the United States.

Mr. **Walgren**. Would you like to comment, Mr. Landau, on whether or not there is a level of information that perhaps we might gather and be very anxious to have everyone in our society have access to?

Mr. **Landau**. Yes; because this is one of the reasons, I think, originally we were—it was suggested to us to approach this as a neutral party. I think there are many industrial concerns who would like to share information, particularly in the area of Japanese technology, or at least participate in joint efforts to gather this information, but for various reasons are afraid to, perhaps because of antitrust matters, or because of competitive matters.

A number of these organizations had said to us, why don't you try to do it because you represent a neutral entity? Similarly, a Government agency could represent a neutral party in this matter and could collect a core of information and make it available to all. Take particularly in some of the high-cost areas such as translation, where some costs that have been quoted to us are as high as $70 per abstract to translate from Japanese to English—this could be an area where the Government could provide some support for industry as a whole.

Mr. **Walgren**. Um-hum.

Mr. Polsky, how recent was the American Electronics Association effort over there? Is there any experience with that, or is that still ongoing?

Mr. **Polsky**. No, I think it's just ongoing. In fact, I made an effort to talk to them just prior to my testimony here and I was not successful in reaching them. I think their project is in the process of just starting, as I understand it.

Mr. Walgren. Now, Mr. Landau, your awareness service, was that focused on a given area of scientific expertise? I am just interested in this idea of the American Electronics Association making an effort in this area. We have other associations, I am sure, in whose interest it would be to all their members to make an effort in those areas. And you had tried to single out a certain area, was it not?

Mr. Landau. We had two levels. We had one level which addressed itself specifically to electronics and computer science—electronics and computer science, and telecommunications.

We had a much broader level that addressed not only those three areas but aeronautics and aerospace, bioengineering, chemical engineering, civil engineering, material science, mechanical engineering, metallurgy, mines and mining, photo optics, shipbuilding, and transportation.

But we saw electronics as being a key interest area in itself.

Mr. Walgren. Now, would there be any comparable associations that would be interested in supporting that? Apparently the American Electronics Association was interested in supporting something. Was your inquiry sent both to companies as proprietary institutions and then also to some of the associations of interest in our system?

Mr. Landau. We sent it only to companies, not to trade associations.

Mr. Walgren. Because I'm wondering whether there might be a market with the trade associations.

Mr. Landau. Yes, that——

Mr. Walgren. Where there's a circumstance where everyone would have access to the information and there might be enough members that the burden could be diffused.

Mr. Landau. We would welcome any suggestions in that area.

Mr. Walgren. Well, I appreciate both your testimonies. And I want to ask Dr. Tsukahira if there's anything that you'd like to comment on?

Dr. Tsukahira. Well, I hadn't really expected to have this opportunity but I appreciate the chance to say something. And I would like to just focus on the language problem which is universally recognized as the important barrier in this whole problem.

But I hark back to my own experience as a teacher of Japanese in the military intelligence language service during the war. And then we had plenty of motivation; there was a demand; and we trained hundreds of GI's to serve as military translators, and so on. Many of these people, after the war, went on to join the Foreign Service or become members of the academic staffs of the universities. And we had a tremendous body of bilinguistic talent in the United States.

I think the problem today is that that generation is passing out of the picture and the new generation is not motivated in the way the first group was. And I think the basic problem is motivation.

Now, in the testimony so far there have been references to the fact that certain companies, certain trade associations, are motivated enough to try to go to the expense and trouble of setting up translation, a search, and indexing efforts in Japan, or here.

I think the major problem comes in when you talk about general coverage of the scientific literature, which would benefit the U.S. industry as a whole. Here is where you lack this motivation. It's the individual company which is trading with Japan that has a specific reason for wanting to get that information. Trade associations that want to protect their industry against competition use this as their defensive reaction to perceived competition and competitive threat.

But it's the broader picture of getting the scientific and technical information that is available to the general U.S. business world and to the scientific and technical world, and the academic world, which needs some kind of motivation. Basically it is the realization that there is a need, but that is a problem, I think, of education.

But I think this is where our government can help by providing the seed money, as someone has mentioned, certainly there should be a deepening of awareness that this is resource that cannot be left neglected for very long without ourselves, our own interests suffering.

Mr. WALGREN. Thank you, Dr. Tsukahira.

You raise the thought that in times past we had a greater focus on this and that there were people who were interested and culturally able to explore those areas. I suppose that was largely out of a defense-related need stemming from World War II and the question is whether or not there's much interest in the defense community in accessing this information and making it generally available.

We now see the defense side of our Government pursuing the newest computers out of a national defense interest. And it strikes me that if you wanted to know everything about that area, you would certainly make a maximum effort to access the Japanese scientific community to be sure that you were on the leading edge of whatever was known at that point.

Can you make any estimate of the effectiveness and the adequacy of our Defense Department in gathering this information? And would they, then, make that information generally available to the public? There is no reason not to I would think.

Dr. TSUKAHIRA. I have no way of knowing in detail what is the extent and the scope of the effort made by our defense agencies, but I could hazard a guess and say that it's very strong. There's very strong motivation there.

The problem there is that such information isn't being disseminated. The reasons I cannot say, whether it's simply that it's classified automatically or otherwise, and whether it's deliberately being withheld, or whether there are technical reasons why it cannot be disseminated.

Dr. TSUKAHIRA. But I certainly can say that this is not adequately accessible by the general public.

Mr. POLSKY. Mr. Chairman?

Mr. WALGREN. Mr. Polsky?

Mr. POLSKY. Learning a foreign language—and I know since I speak a couple of them so terribly and in fact hardly at all now—is a difficult process. And probably Japanese is, as my colleague would say, one of the most difficult. And another colleague in my company, Mr. Harding, who is a Chinese language linguist, would say the same. You have to have a very powerful motivation and incentive to learn and, of course, the period that Dr. Tsukahira refers to during World War II, when we had a tremendous need for tactical intelligence officers right on every island in the Pacific, I mean, that was a crushing national crisis that we had, which provided a lot of very dedicated Americans with that extra motivation to do it. And you get into these subjects of trade, and economics—and it's pretty hard to relate a business crisis in the Ohio Valley to the need for learning more Japanese, for example.

I don't personally have the answer to this question of how you really motivate people enough to go through the tremendous drudgery and repetition of learning Japanese. I haven't studied Japanese.

I was a correspondent for a number of years in the Far East, and the way I managed it was that I had a lot of local friends in the different countries that I was in, that plus the translations that were available to me. It's a tremendously time-consuming effort. Anyway, I mean, maybe some people on your subcommittee or elsewhere—it's a hard one, I mean, maybe the Government ought to give $100,000 language fellowships or something.

Mr. **Walgren**. Well, it's a tough question. Certainly many of us view the Government's role as that of providing the opportunity. Coming from the Pittsburgh area, we certainly need to know that if we wanted to have the information we could. Without information, you have no opportunity.

It would be an interesting thing to wonder what the Nation would be like, or what our attitude toward funding libraries would be like, if it weren't for Andrew Carnegie.

Now, there wasn't a real reason for Andrew Carnegie to be interested in libraries. He might have been interested in mobiles, or modern art, and had he not been interested, we might find the Government in the library business with both feet.

So, you know we certainly do have to try to make sure that we are asking ourselves what is the reasonable thing that we can expect to happen, and that we have to try to make happen for the protection of the national interest. And sometimes I think that means shedding some old ideas about what's the proper role of X, Y, and Z.

Mr. **Polsky**. May I make one additional remark, please?

I think perhaps the first obstacle to be overcome is American impatience and unwillingness to operate and play on a long-term basis internationally or even, for that matter, to plan domestically on a long-term basis.

If that is overcome, and you manage by a variety of sticks and carrots convince the American companies that they should be systematic and patient in the long-term collection of scientific data, maybe then you can find that acquisition of language expertise might not be so difficult.

Mr. **Walgren**. Well, thank you very much on behalf of the committee. We certainly appreciate your participation in this exploration. And we appreciate your being a resource to the Congress.

Mr. **Polsky**. Thank you very much.

Mr. WALGREN. Well, let me call the next panel at this point. Dr. James Bartholomew of the Department of History at Ohio State University; Dr. Eleanor Westney, the acting director of the Japan's science and technology program at the Massachusetts Institute of Technology, and Susan Goldman, who is a research scientist with the Courant Institute of Mathematical Science, located at New York University.

Welcome to the committee and, again, written statements will be made a part of the record. And in the interest of time, let me ask you to summarize and make the several points that you feel really cry out to be made and know that if you do that you will have made the best contribution to the record that you possibly could.

So let me ask you to proceed in that order. Dr. Bartholomew?

TESTIMONY OF JAMES R. BARTHOLOMEW, DEPARTMENT OF HISTORY, OHIO STATE UNIVERSITY, COLUMBUS, OHIO; D. ELEANOR WESTNEY, ACTING DIRECTOR, MIT-JAPAN SCIENCE AND TECHNOLOGY PROGRAM, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, AND SUSAN GOLDMAN, RESEARCH SCIENTIST, COURANT INSTITUTE OF MATHEMATICAL SCIENCES

Mr. BARTHOLOMEW. Thank you, Mr. Chairman.

I must say that I was personally very pleased to see the committee holding these hearings and I hope that I can make a useful contribution to them.

It's my personal judgment as a historian and sociologist to science in Japan that we do in fact in this country have a very serious problem keeping in touch with what the Japanese are doing and gaining access to information that is coming out of there.

For example, research and development spending in Japan for the civilian sector as opposed to military is now about equal to the spending in the United States even though Japan has half of our population.

Second, Japan is currently accounting for 40 percent of all patent filings worldwide; in this country we are accounting for about 10 to 12 percent of patent filings.

Third, while the United States continues to enjoy a favorable financial advantage in technology license agreements with Japan, that is, we are still receiving more money for technology from them than they are getting from us; the fact is that in recent years, since about 1975, they have been selling us more technology than we've been selling them. I don't think that these facts are widely known in this country but they are in fact the situation.

Now, you can ask the question: Well, is the problem really as bad as people claim? Some Americans will say, well, after all, in recent years our people continue to win most of the Nobel Prizes; most scientists around the world supposedly are using English and; second, or third, U.S. R&D spending is still the highest in the world.

Personally, I think that none of these are very good indicators of the relationship between our scientific and technical research effort and that of Japan.

For example, Nobel Prizes typically recognize work that's done 10, 15, 20, or 25 years in the past. Japan has yet to win a Nobel Prize for anything they've done in the past 25 years. You cannot use Nobel Prizes as an indicator of current contributions to science worldwide or to current standing in science worldwide. It's totally meaningless.

Second, the use of English is a two-edge sword. What it means is that foreigners can easily find out what we're doing but we, not knowing foreign languages, have trouble finding out what they're doing.

It's not correct that the Japanese are putting out most of their stuff in English. Most of it is coming out only in Japanese, that's true in science and it's also true in engineering. And as Mr. Landau from Engineering Index pointed out, we are not keeping up with the Japanese literature output at all. I think in fact the problem is substantially worse than if anything we tend to recognize.

The Japanese, for example, concentrate their effort very heavily on engineering, although they have been making more and more of a commitment to basic science of late. There is an additional problem in the fact that so much of the engineering research effort in Japan is done in the private sector, specifically the private corporate sector and, therefore, tends to be the information produced of a proprietary nature; it's hard for us to gain access to that.

Engineers in particular tend to rely much more on oral communication to find out things that are going on as opposed to scientists who typically rely very much on written communication, although they, of course, use the oral means as well. And as Mr. Landau has testified, Engineering Index is currently covering only 130 out of the 4,000-plus engineering journals that the Japanese are putting out, and not one of those 130 journals out of Japan is being published in Japanese where, in fact, 80 percent plus of their effort is wholly concentrated.

I would like to make a couple of other sort of commonsense observations, too, by which we might try to gain some understanding of what the Japanese are doing.

There's been more and more atttention in the last few months to the relative strength of American secondary education as compared with the high schools of Japan. The Japanese have a very tough and very demanding school system compared to the rather lax one that's so often existing in different parts of the United States. Their school year in Japan is 240 days out of the calendar year; in the United States it's 180. Nobody gets a high school degree in Japan, nobody, without 3 years of math, two of science, three of English, three of social studies, and three of Japanese.

Moreover, for the past 20 years, beginning in 1964, there have been carried out by UNESCO international tests of high school students' performance worldwide in mathematics and in science, and every time these tests are given, the Japanese come in No. 1, and the United States is down in about No. 15 spot.

It is very interesting to notice that of those Japanese high school students who 20 years ago tested out first worldwide in math and science performance, they are now, of course, all in the Japanese labor force at the peak of their productivity and earning capability. That is something I think should concern us.

What might the United States do to deal with this situation?

First of all, the Federal Government, in my opinion, has got to become involved in developing the capability to monitor Japanese scientific and technical research. Partly this is because of the need for it to be done quickly and there are not nearly as we've seen enough American scientists and engineers aware of the potential benefits of keeping abreast of Japanese developments.

Once the capability, from a technical standpoint, is developed here, I should think private firms could handle the dissemination on a continuing basis.

What we need is for development of the capability of handling the Japan Information Center for Science and Technology tapes, JICST tapes, through English language access points, key words, and subject headings. For example, the Japan MARC machine readable catalog tapes or books that are produced by Japan's National Diet Library, which is like our Library of Congress here, plus the JICST tapes, the Japan Information Center for Science and Technology tapes of scientific articles should be made compatible by machine conversion with successful existing data bases in the United States.

They have their own Japanese data base as we have ours for chemistry, and biology, and other fields. But the key words are not nearly case compatible, they should be made compatible. That will cost a great deal of money. And we can be sure from the testimony that we've already heard that private sector organizations by themselves are very unlikely to do this, or even to be able to afford to do it. It is something the Federal Government should undertake.

Second, the National Technology—NTIS, National Technical Information Service, is properly constituted to serve as a kind of center for Japanese scientific technical efforts. It's a major national resource which we have been underfunding in a dramatic way. Other countries, of course, other industrial democracies, have this kind of agency, but in those other cases, Japan, with its—Japan Information Center for Science and Technology, those foreign organizations get subsidies from the respective governments. NTIS, as we've seen, has to subsist on user fees. I think this is anachronistic and should be changed.

We could then use, of course, this dramatically increased NTIS effort in very valuable ways, making the information available to the private sector as they show an interest in it.

I think we should consider also having the Federal Government develop funding programs for libraries around the United States which are systematically collecting technical and scientific periodicals from Japan. There are about four such organizations right now; a couple of them will be represented in the testimony tomorrow. There should be a system of grants from the Federal Government to support those collection development efforts.

The Federal Government, of course, is already doing this with university libraries in social sciences, humanities and fine arts, but it is not doing it in technical fields where the need is at this time the greatest.

Last, I would suggest that the Federal Government should develop a technical translator fellowship program. Mr. Polsky spoke about that and I would like to underscore what he said. We already, of course, have been giving fellowships now for more than 20 years to American nationals to learn Japanese, among other foreign languages, with fellowship allocation programs to the title IV, title VI programs that the Eisenhower administration and the Congress enacted back in the fifties.

There is no reason we couldn't extend this to handle translation, Japanese technical translation efforts by students who are pursuing technical degrees and who might also be induced, if the fellowships were available, to become professional translators. Clearly there is a big need for this and I'd like to see the Federal Government get into that in a big way.

[The prepared statement of Mr. Bartholomew follows:]

Prepared Statement for the
U. S. House of Representatives
Subcommittee on Science, Research and Technology

March 6 - 7, 1984

James R. Bartholomew
Department of History
The Ohio State University

Introduction

The need to obtain scientific and technical information from Japan and the difficulties of doing so at this time are both substantial. Moreover, the number of individuals and organizations aware of the problem is still quite small, although rising. And counter-strategy which hopes to succeed in the short or longer term must begin with these facts.

Government Sector

National Technical Information Service

Let me begin with the National Technical Information Service (NTIS) in discussing what the federal government can do about this problem. As a functioning institution with ostensibly national responsibilities in information gathering, NTIS is properly constituted to serve as a focus for significant new efforts. These should include:

Translation NTIS should immediately commission full translations into English of two reference works in Japanese:

1) Kenkyu Tema Jiten (Directory of Research Projects). Published every two years, most recently in 1981, this large work (over 3,000 pages) reports invaluable information on all scientific and technical research projects underway in Japan's government-run universities. Information reported includes the research project title, a summary of the technical contents, brief account of research findings to date, a list of related publications, the name of the principal investigator, institutional affiliation, professional credentials, address and telephone number of the laboratory.

2) Kuni no Shiken Kenkyu Gyomu Keikaku (Japanese Planning for Industrial Research and Testing). This is the basic source of information on all research projects with commercial applications presently underway in Japan, sponsored by various agencies of the Japanese government. It is compiled annually by the Science and Technology Agency (Kagaku Gijutsu Cho), beginning in 1981. Information presented includes the name of each research project, a summary of the technical contents, the budget, anticipated completion date, names of the researchers, location of the laboratories and their telephone numbers. The Japan Information Center for Science and Technology - JICST - (Nihon Kagaku Gijutsu Joho Senta) has officially called it a "valuable, indispensable source."

Information Diffusion Having rendered the aforementioned materials into English, NTIS should then publicize their availability to any and all interested clients, including abstracting and indexing services, as well as universities. The "A & I" services are important because they serve so many clients, and communicating with them will eventually stimulate broad based demand for technical information from Japan. The universities are important not only because of their basic research functions, but because the university researchers in general - there are significant exceptions - appear to be less, not more, aware of Japanese research activities than do American scientists in industry.

Budget for NTIS I cannot say what the budget for NTIS should be. However, it is clear to me that the $75,000 or so available to it for Japan-related activities in 1982 or 1983 is totally inadequate. The more substantial Japanese collections at American university libraries, including our own at Ohio State University, each spend more than this figure every year.

Moreover, it is anachronistic to think that an important national agency like NTIS can subsist adequately on income from user fees alone, as it does at present. Congress should indeed be cautious about new funding commitments in general. But this agency should be granted regular budgetary subsidies. Other major developed countries, including Japan with JICST, have agencies similar to NTIS, and those countries are already subsidizing their agencies for the collection and diffusion of technical information.

Library of Congress (LC) and Related Institutions

I refer here to the National Library of Medicine and the National Library of Agriculture, as well as LC itself. These agencies all collect technical publications and reports from Japan. However, many potential users are quite unaware of the strength of their collections, even when these users know the Japanese language. Unfortunately, given their basic constitutions and modes of operation, these agencies cannot directly publicize their holdings in any systematic fashion. Under the present American mode of operation, moreover, scientific and technical information gathering and diffusion belong principally to the abstracting and indexing services (e.g. Chemical Abstracts Services, Engineering Information, Inc.) which are essentially private businesses. This is a major respect in which the American information collection and diffusion effort differs sharply from that of Japan - not to mention the Soviet Union.

Private Sector

Collection Building Grant Support

Some institutions in the private sector are already collecting technical and scientific information from Japan and making this available to the public. The major ones at present are: Center for Research Libraries (Chicago), the Linda Hall Library (Kansas City), the John Crerar Library (Chicago) and the New York Public Library (New York City). All have reported greater user demand for this material in the recent past. The federal government might choose to assist such private sector institutions - as well as public and private universities - to develop or expand such activities through a system of competitive grants akin to the Title IV and Title VI programs of the National Defense Education Act, authorized in the 1950's and continuing to the present.

Technical Translator Fellowship Program

Designers of federal assistance programs in this area must bear in mind that scientific and technical researchers do not all access information in the same way. In some fields (e.g. chemistry) perusal of journal articles is very important. In other fields (e.g. electrical and mechanical engineering) site visits to co-workers' laboratories and oral communication may be more important. For many American engineers especially - and it is in engineering, more than science where our American effort to keep abreast of Japanese developments most falls short - the greatest need is for oral as well as written communication. One could address this problem by training some of the engineering researchers themselves in Japanese language, by recruiting those with undergraduate technical training into the Japanese technical translation field, or by both strategies. It is possible for individuals to pursue an engineering program simultaneously with the study of Japanese, but one should not assume this will happen on any large scale without additional financial incentives, i.e. scholarships.

Conclusion

From the point of view of research competition, it is important to stress that the Japanese have long had access to U. S. information in technical fields, not only through customary acquisition channels, but electronically through the purchase of machine-readable MARC tapes. Thus, the data base of JICST includes not only several thousand Japanese language periodical titles and technical reports from Japan, but also the holdings on tape of Chemical Abstracts Service and other U. S. technical data bases. JICST has produced and will sell its own tapes, which include the Japanese language technical materials to American customers, including the Library of Congress which reportedly now owns them. Moreover, using key words from English with Japanese language equivalents, it is already possible from a technical standpoint to perform Boolean searches in this country of the JICST scientific and technical data base. American users who request this service can then arrange for translations of the material.

I stress this point to underscore the fact that some of our problem in this country derives from the ignorance of potential users of what the Japanese are producing and have produced, and for someone to do something about this ignorance. From a political standpoint, this problem of ignorance needs to be addressed before adequate technical and programmatic responses will be feasible on a large scale - or perhaps even a smaller one. However, this situation is volatile and will change in the future.

Biographical Sketch

James R. Bartholomew is Associate Professor of Japanese History at the Ohio State University in Columbus, Ohio. His major research and teaching interests have concentrated on the history of science, technology and business in Japan. He has published numerous articles in this area and is currently writing a book entitled The Formation of Science In Japan, which deals with Japan's creation of a modern research tradition in the 19th and 20th centuries. In 1976-77 Mr. Bartholomew held a Fellowship for Independent Study and Research from the National Endowment for the Humanities. In 1977 he was a Visiting Fellow at the Institute for Advanced Study in Princeton, New Jersey. Since 1982 he has done contract research for private firms and laboratories on accessing technical and scientific information from Japan.

Mr. **Walgren**. Thank you very much, Dr. Bartholomew.

Let's then turn to Dr. Westney.

Dr. **Westney**. It's a—it's a great pleasure for me to be here today. I only regret that Dick Samuels, who is the creator of the MIT-Japan Science and Technology program, could not be here today. He is in Japan this year doing research and is watching these hearings with great interest.

I won't belabor what Dr. Bartholomew has already said about the enormous importance of Japan's research and development capacity, which is already high and likely to increase in the future. And I would like to underscore that. This is not a temporary need; this is not a temporary shortage. Japanese research and technological output is only going to increase in the future.

And I would just like to add one more indicator: The Japanese university system is now graduating and has for the last decade, graduated more electrical engineers in total than the United States, even with the population base half the size. And we are just beginning to see the results of that.

Moreover, government and industry policy is being driven by an evaluation of Japan's competitive situation in the world marketplace to emphasize the development of its research and research capacity both in science and in applied technologies.

There is going to be growing, not decreasing, importance to U.S. researchers in academia, in industry, and in Government in keeping abreast of Japanese science and technology .

In doing so they face at least three difficulties, and these have already been mentioned so I won't belabor them.

The first and most important is language. This country has an acute shortage of people who are literate both in Japanese and in a technical field. The language programs that have been developed in this country in Japanese language have been heavily slanted toward the humanities, and slightly less toward the social sciences.

Those language centers that exist are at universities which are primarily centers of humanities and the language programs have been constructed for those who are concentrating in Japanese studies, not for people who are adding Japanese as a tool to use in addition to another major, particularly in scientific and technical fields. And I think this is—this is of crucial importance and I want to come back to that.

The second disadvantage that this country faces and something that I would like to call scanning capacity. Because the United States has been a technology leader throughout this century, it has not developed the Government and even the industry infrastructure to monitor foreign technologies, particularly in those countries which have been regarded not as technology leaders but as technology followers. And since Japan has been regarded as a technology follower, this country has not, understandably, has not put resources into monitoring it; and it's difficult to shift those patterns rapidly.

The shortage of Government attachés who are monitoring Japanese science and technologies has already been pointed out. Those that exist carry a heavy burden and do an excellent job, but the manpower is simply not there.

In fact, if the Government does not move in to take some rôle in increasing the monitoring and dissemination of Japanese scientific and technical literature, by default private industry that picks up on this will be the large-scale companies that have a comparative advantage because they already have an industry presence in Japan.

The large-scale global corporations will be able to monitor Japanese science and technology, but that will not be passed on to the rest of American industry; it will be proprietary information that confers a competitive advantage. And the medium-scale and smaller scale companies that have been, in many cases, the driving force behind America's technological development, will be at comparative disadvantage. And I think it's very important to underscore that in emphasizing the importance.

And I would like to point to the Japanese Government as an example of the importance of this. The Japanese Government role has equalized access to foreign technology to all Japanese industry, not just the very large-scale companies that can afford to invest in the manpower to build private proprietary scanning systems.

A third difficulty that Americans face in trying to monitor Japanese science and technology is the fact that all the indicators we have, and we lack any systematic information—again, I would like to come back to that later—all the indicators we have suggested, the Japanese scientific and technical community rely even more heavily than their American counterparts on what we could call the invisible college: the network of informal communications.

Japan's scientific and technical research facilities are relatively highly centralized in one part of Japan in a relatively small country, and a relatively small number of key institutions, and they have very important personal contacts; partly because of this, partly because the Japanese publishing mode has been oriented to volume and to house organs—companies with their own journals, universities with their own journals. There's a huge volume of publication in Japan with relatively less quality control and, therefore, it's harder to keep up with the cutting edge in terms of the printed information. You really need access to people who can tell you what's important, and alert you to the keyworkers. And that means creating people, or fostering people, who have the skills to function in a Japanese research setting. And, again, this is something that this country has not developed.

Now, it's very clear, I think, what I'm leading to in terms of a government role in this. The government has the key role in investing in long-term resources, particularly in the language issue.

The question of motivation has been raised by some of the people who have spoken here today. At MIT, we have seen that the motivation is indeed there. The MIT-Japan science and technology program, as one of the elements of its activities, sends young MIT graduates in science and technical fields to Japan to spend a year in Japanese labs, either in university or in government or in industry labs.

We insist that they have Japanese language before they go. And they acquire this very painfully because MIT has not built its own in-house Japanese language capacity. And, again, I'd like to return to that.

We currently have our first cohort of students 6 working in Japanese labs this year. We expect to have as many going next year. I believe we could quickly triple that if we could offer technically oriented Japanese language course at MIT. But given the resource space of universities in this day and age, it's very, very difficult for universities to construct new language programs without the kind of government funding and seed money that made the original language programs possible.

That's a key long-term need that's been emphasized over and over again: language programs oriented to scientific and technical people at the college level so that they don't have to acquire it very painfully when they've moved on into the work force.

A more short-term, but I think equally urgent priority, ought to be some very careful analysis of the processes of Japanese scientific and technical information gathering and dissemination, both here and in Japan. Some analysis of the Japanese Government role in constructing the very successful information gathering and dissemination systems that now exist in Japan, could, I believe, provide some very useful guidelines for this country in the future.

And although I know there's a built-in bias against academics always suggesting the need for studies on which to base policies rather than suggesting policies, I think this is one area where study would be an absolutely essential investment.

In conclusion, I would just like to point out that much has been written in the business and technical literature lately about the Japanese challenge to America. I think in a real sense, the most important challenge to this country is to make an investment in the resources that will improve cooperation, coordination, and mutual knowledge and respect in scientific and technical fields as well as in the broader cultural and political fields.

Thank you.

[The prepared statement of Dr. Westney follows:]

Statement by

D. Eleanor Westney, Acting Director
M.I.T.-Japan Science and Technology Program
Massachusetts Institute of Technology

Before the

Committee on Science and Technology,
U.S. House of Representatives

March 6, 1984

With the world's third largest scientific research establishment, Japan is now making increasingly significant contributions to science and technology. Yet U.S. researchers in universities, corporations, and the government do not find it easy to keep abreast of Japanese scientific and technical information, not because of some conspiracy on the part of the Japanese to conceal their achievements but because this country, with its long tradition of world leadership in science and technology, has not cultivated the resources for learning about developments in Japanese research. Universities, corporations in industries in which Japan has been developing a major research-based presence, private consulting firms, and the abstracting and indexing services are moving to meet the growing demands for Japanese scientific and technical information. But they face serious problems in doing so, and the federal government has a crucially important role to play in helping them solve those problems.

1. Japanese Scientific and Technical Research

In terms of both the total number of researchers and absolute expenditures on scientific and technical research, Japan now ranks third in the world, behind the United States and the Soviet Union. By the late 1970s Japan had over 281,000 full-time research personnel (compared to the U.S.'s 630,000) and was spending nearly 20 billion dollars annually on research, slightly less than 40% of total U.S. research expenditures (data from the Japanese Office of Science and Technology's White Paper on Science and Technology 1981 - Kagaku Gijutsu Hakusho Showa 56). The growing strength of Japanese rsearch and development is reflected in the changing patterns of Japan's technology trade. Japan remains a net debtor in technology because of past licensing agreements; however, in terms of new contracts, Japan has since 1972 earned more by licensing its own technology abroad than it has spent in acquiring new foreign technology.

Japan's strength in science and technology is likely to continue to grow. Japanese universities now produce more graduates in scientific and technical fields than do U.S. colleges and universities, even though Japan's population is roughly half that of the United States. In electrical engineering, for example, Japan has produced more graduates than the United States since 1973 (Uenohara et al: 34). Both the

Japanese government and Japan's major corporations are determined to encourage the growth of their country's resources for scientific and technological advance. In other words, the need for those active in research in this country to have access to Japanese developments in their fields is more likely to increase than to diminish in the future.

2. Problems in monitoring Japanese Science and Technology

There are three major problems confronting those who want to keep abreast of Japanese developments in science and technology: language; the relative weakness of this country's technology scanning capacity; and the systems of scientific and technical information gathering within Japan itself.

Language is a critical issue. There are very few Americans who have the ability to read and speak Japanese. Even fewer of those are also experts in a scientific or technical field, able to assess the significance of what they read. There is a widespread belief that all important scientific information will be published in English. This is probably true for the realm of pure science; however, the closer one gets to applied fields, the less certain it is that information will be published in English, and the more critical the time lag involved in that process is likely to be.

The language problem can be seen as a significant element of a larger problem: the imbalance between Japan and the United States in terms of resources for technical scanning. The Japanese have been building organizational systems and manpower resources for learning from the technologically advanced countries of the West for over a century. As the world leader in science and technology, the United States has not felt the need to cultivate its learning capacity to nearly the same degree. For example, U.S. corporations have far fewer people who can function as technology scanners in Japan than Japanese corporations have in this country. Every year M.I.T. has a number of Japanese studying for advanced degrees in the sciences who are sponsored by their companies. How many U.S. corporations are willing to send their people to a Japanese university even for a summer?

A third aspect of the problem is, however, the organization of scientific and technical information in Japan itself. Japanese scientific and technical information is less systematized and readily accessible than is the case in the United States. There are far fewer refereed journals; most Japanese researchers tend to publish in their own university's or company's journal than in national publications. Such "house organs" tend to be of very uneven quality. Perhaps for these reasons, Japanese researchers seem to rely less on abstracting and indexing services (of which there are far fewer in Japan) and on publications than their American counterparts. In both countries the "invisible college" of informal contacts and acquaintances provides the researcher with an important guide to significant new research, but in Japan it is critical. The Japanese government is currently working with academic and industry people to improve its own scientific and technical data bases, which are widely seen to be inadequate. Until they succeed in upgrading them substantially, however, a reasearcher wanting to become integrated into Japanese science and technology effectively will require the building of a personal network. That requires not only Japanese language ability but also the ability to interact comfortably with Japanese colleagues in a Japanese setting, and this is something that all too few of our own researchers have acquired.

3. Addressing the Problems: The Private Sector

The growing demand for information on Japanese science and technology is producing a rapid increase in the information provided by the abstracting and indexing services and by private consultants. Large U.S. firms in industries where the Japanese are seen as developing significant capacity for original research are moving to set up research and development facilities and scanning offices in Japan. Educational institutions are also moving to meet the challenge.

However, these organizations face two key difficulties. One is the acute shortage of people who are literate both in Japanese and in scientific and technical fields. The second is the difficulty of assessing how adequately the information they are collecting actually covers the entire range of significant Japanese scientific and technical information. These are the areas in which the federal government has a crucial role to play.

4. The Role of the Federal Government

The federal government role lies in two major areas: one is language training, which involves a long-term commitment, although the mechanisms for such a commitment are already in place; one, the funding of a systematic analysis of scientific and technical information gathering and dissemination, is more short-term.

a. Language Training

The U.S. government did much to foster the expansion of Japanese language training in this country, first during World War II (which produced many of the key architects of Japanese studies in this country), and then through the NDFL program of the 1960s and 1970s. Most of this support for language training, however, went to produce Japan specialists, mostly in the humanities. None of the language programs were geared to students whose primary commitment was to a scientific or technical field. As a result, the Japanese language programs in this country, with one or two notable exceptions, do not address current needs in science and technology, and indeed do not even provide a good basis for expansion to meet those needs.

Let me give our own M.I.T.-Japan Science and Technology Program as an example. A key part of our activities is sending M.I.T. students in scientific and technical fields to Japan for a year to work in laboratories in universities, government labs, and private firms. These students must be outstanding in their specialities, and they must have studied Japanese language before they go. Currently we have six students in Japan, and we hope to have as many again this year. To lay to rest any lingering suspicions that part of the problem lies with Japanese "secretiveness" I should say that we have more offers from Japanese companies to accomodate qualified interns than we have qualified candidates. And the critical stumbling block in recruiting more candidates is language. We do not have Japanese language classes at M.I.T; we must send our students to Harvard for their language training. On the face of it this does not seem unreasonable. Although some observers have suggested that Harvard and M.I.T. are on different planets, they are only a short subway ride apart, and the Harvard language program is one of the finest in the country. However, in reality it imposes heavy burdens on our students. The M.I.T. curriculum is extremely demanding; the Harvard language program at the first year is "Intensive Japanese". Class hours, designed for students for whom language is the center of their course of study, frequently conflict with required courses in engineering here at M.I.T. Moreover, once past the first year, the vocabulary and the themes of the lessons reflect the interests of the Harvard students in history, literature, and culture, rather than in semi-conductors, researchers, and labs.

A revitalization of the NDFL program, directed at centers of scientific and technological research with strong ties to industry and government, would be of inestimable value to us and to institutions like us, who are trying to provide access to Japanese science and technology for the scientists and engineers of tomorrow. And as in other areas of education, this represents a long-term investment in the national interest that only the federal government is in a position to make.

b. Assessing Information Coverage

Last January (1983) the M.I.T.-Japan Science and Technology Program organized a conference on Japanese Scientific and Technical Information, with funding from the Department of State and the National Technical Information Service. It brought together most of the people actively involved in gathering and disseminating information on Japanese science and technology in industry, abstracting and indexing services, universities, government, and research libraries. There was general agreement on not only on the crucial importance of the lanuage issue, but also on two short-term strategies for beginning to tackle the significant imbalance in the flow of technology across the Pacific. One was to try to achieve greater public awareness of the scope of the problem, something I believe these hearings will do much to bring about. The second was to fund a major study of the processes by which Japanese scientific and technical information is gathered and disseminated both in this country and in Japan. This should in fact be part of a somewhat larger study: an analysis of the government's role in facilitating the flow of foreign scientific and technical information into Japan. Such a study could illuminate the processes by which government can play a constructive role in the process.

5. Conclusion

There is no doubt that despite the great anxiety exhibited by some analysts, the United States is still preeminent in many fields of research. Yet Japan is becoming and will continue to become a major generator of scientific and technical knowledge. To be without adequate access to that knowledge will be a serious disadvantage to science and to industry in this country. I hope that this subcommittee can persuade Congress of the importance of this issue and of rapid action on it.

D. Eleanor Westney

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B.A., University of Toronto, 1970
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Ph. D. (Sociology) Princeton University, 1978

Professional Experience

1975-76:	Research Associate, Hitotsubashi University, Tokyo
1976-78:	Lecturer, Department of Sociology, Yale University
1978-79:	Visiting Fellow, Department of Sociology, Princeton University
1978-82:	Assistant Professor, Department of Sociology and School of Organization and Management, Yale University
1982-	Assistant Professor of Management, Sloan School of Management
1982-	Research Associate, Japan Institute, Harvard University

Publications:

Organizational Development in Meiji Japan (forthcoming)

"Western organizational models in Meiji Japan: The case of the Keishi-cho and the Paris Prefecture of Police" Journal of Japanese Studies (Summer 1982)

"Japan's mass media system in comparative perspective" in The Japanese Mass Media (forthcoming)

"The Military" (Chapter 7) in The Tokugawa-Meiji Transition (Forthcoming)

"Japanese and U.S. Media: Graphics as a reflection of newspapers' social role" (with James R. Beniger) in Journal of Communication (Spring 1981)

"Patterns of Organizational Development in Japan: the spread of the incorporated enterprise" in Dunkerly and Salaman, eds, The 1979 Yearbook of Organizational Research

Current Research

Beyond Japanese Management (with Hiroyuki Itami): a critical look at theories of Japanese management

A study of the organization of research and development in the computer industry in Japan and the U.S.

THE MIT-JAPAN SCIENCE AND TECHNOLOGY PROGRAM

The Massachusetts Institute of Technology established the M.I.T./Japan Science and Technology Program in 1981 to promote dialogue between scientists and engineers in the United States and Japan. There are three principal elements in the Program: the dispatch of MIT students and graduates in scientific and technical fields to work and study; the enhancement of flows of Japanese scientific and technical information into the U.S.; and the study of research and development organization in Japan.

Among the principal activities of the program are the internships it provides in Japan for M.I.T. science and engineering students who have already acquired some language facility and cultural understanding of Japan; they are then able as interns to perform research in Japnese industry and universities. In this way, they gain firsthand knowledge of Japanese science and technology as part of their formal education, and are then in an excellent position to continue to follow developments in Japan, and work closely with the Japanese in their later careers.

No other institution of higher education in the United States is providing such an educational opportunity for students with sophisticated technological backgrounds. By supplementing these students' expertise in engineering and science with the skills needed to interact with the Japanese, the program fills a gap in American technological education, increasingly important today and for the future. Eventually, the program could have long-term effects on science and engineering education not only at M.I.T. but also at other universities, by example and through dissemination of the program's training materials.

In the area of JSTI (Japanese Scientific and Technical Information), the Program has sponsored several workshops and symposia on the subject. One, a conference on "High Technology and Japan's Industrial Future," was attended by nearly two hundred business and government officials. Another, a more intimate workshop for professional acquirers and disseminators of Japanese scientific and technical information, which was held for two days at M.I.T.'s Endicott House, provided government and private sector monitors, reporters, and abstracters their first opportunity to come together to share their knowledge and experience. Our next conference, "Japanese Scientific and Technical Information", is oriented to a broader industry and government audience, and examines the topic from the viewpoint of the researcher, information specialist, and that of the corporate user.

Our third major focus is on research into the research process itself. Despite the rapid growth of the literature on Japanese management, there is so far almost no information on how the Japanese manage the research process, or on the careers and training of engineers. We are at present conducting, jointly with Harvard University's Program on U.S.-Japan Relations, a comparative study on Research and Development organization in high-technology industry in Japan and the United States. This project analyzes the training and careers of engineers, the organization of research projects, and the management of the research process on R & D in the computer industry in the two countries.

In addition, M.I.T. is active in promoting cooperation among the other institutions in the country, in industry and government as well as in academia, who are engaged in enhancing this country's resources in keeping abreast of Japanese science and technology and in promoting cooperation between U.S. and Japanese scientists and engineers.

MIT - JAPAN
SCIENCE AND TECHNOLOGY PROGRAM

Current Interns in Japan

The following M.I.T. students and recent graduates are at present in Japan. In each case, the M.I.T./Japan Science and Technology Program counselled the student on language and other preparation, helped locate internship opportunities, and assisted with fund raising.

Patricia Cullen was a graduate student in Materials Science and Engineering. She is at Hitachi's Central Laboratory in Tokyo for one year to work in its thin film devices program. Hitachi paid her round-trip air fare and is paying her a monthly salary.

Tanya Sienko graduated with a B.S. in Physics; she also has a B.S. in Japanese from Cornell. She will be doing graduate work in super conductivity at Tokyo University for one year. She has a Japanese government (Monbusho) grant, which provides air fare, tuition, and a monthly stipend.

Robert McGreevy received his B.S. in Chemical Engineering. He is doing graduate work at Tokyo University. His primary interests: chemical reaction engineering, separation processes and heterogeneous catalysis. He has a Japanese government grant, with the same provisions as Sienko.

Peter Poole, a graduate student in Civil Engineering, is studying for one year at Kyoto University. His interests are in environmental systems analysis and pollution control. He has a Monbusho grant from the Japanese government, with the same provisions as Sienko.

Steven Cohen, a junior in Electrical Engineering, is studying for this academic year at Waseda University in Tokyo in that university's Year-in-Japan program, after which he will return to the Electrical Engineering Department at M.I.T.

Monica Strauss, a graduate student combining courses in Electrical Engineering, Japanese studies, and Science and Technology Policy, began field work in Japan in January in the Electro-Technical Laboratory in Tokyo. Her study is concerned with research management and planning in the field of computer science in the U.S. and Japan.

Room E53-447 Massachusetts Institute of Technology Cambridge, Massachusetts 02139 617-253-2449

Mr. **Walgren**. Thank you very much, Dr. Westney.

Ms. Goldman.

Ms. **Goldman**. Chairman Walgren, honorable members of the subcommittee, ladies and gentlemen:

On behalf of New York University I wish to express my appreciation for having been given the honor of testifying before you today.

At the risk of what some of my colleagues have mentioned, I would like to describe a small project that we have initiated at New York University.

I am a research scientist at the Courant Institute of Mathematical Sciences at New York University which houses the graduate and undergraduate departments of mathematics and computer science.

The project with which I have been affiliated since its inception in December 1982, involves the translation of technical materials from Japanese to English. Although it is a very small project and still new, we feel that it is important that this type of work receive recognition as early as possible so that the various sectors, whether private or government, be motivated to assist in the creation and development of similar projects at centers across the country.

In addition to the translation of computer science materials, it is our aim: First, to train computer science students in Japanese so that they will be able to communicate at all levels with their Japanese colleagues; second, to build up a collection of materials so that we may serve as a resource as increasing numbers, hopefully, of young engineers and scientists able to read Japanese; third, to establish and maintain contacts with the Japanese computer science community in order that we may exchange information on a continuing basis and keep all channels open; fourth, to encourage the establishment and development of this type of program elsewhere.

Having created a translation project of this type, literally from scratch, we have found that there are four major problems to confront. I would like to briefly outline each of these and discuss them.

The problems are: recognition of the need for translation, which doesn't seem to be the problem in this room today. Then, of identification and acquisition of the materials to be translated and their translation.

Our project came about as a result of a proposal presented to the Office of Naval Research by the Computer Science and Technology Board which is part of the National Research Council of the National Academy of Sciences.

The proposal led to the organization of a factfinding panel which recommended that specific selections of technical Japanese articles be made and then translated on an ongoing basis. The conclusions were published in 1982, at approximately the same time I returned to the United States after 10 years in Japan.

At that time, I was very surprised to discover that members of the scientific community whom I met did not seem to be aware of any major exchanges with their counterparts in Japan. Japan had learned the lessons of 250 years of isolation, when in the 19th century it had discovered how seriously deficient it had become in basic science and technology in comparison to that in the Western nations.

Since the Second World War, there has been an even greater push to learn from the United States for the simple reason that the work being done here is valuable. In computer science, the enormous strides the Japanese have made clearly reflect positive results.

Japan is a country of approximately 120 million who speak a language all but unknown elsewhere and one which is not related to other languages. This fact alone isolates them and the work they are doing, and creates an enormous burden for them.

The faculty members of the universities in Japan and its business community as well are involved in a daily process to acquire papers, books, and articles from abroad, and then to absorb and utilize them as quickly as possible.

Understanding the work produced by other scientific communities prevents reduplication and broadens the individual scientist's view of his or her own subject.

It would seem that the United States must now begin to acquire information from Japan; something it hasn't been doing.

It may surprise the committee but I still continue to hear from scientists, both within my own university community and elsewhere, that there is nothing published in English because there is nothing worth publishing.

This bespeaks an extremely shortsighted attitude. Publishing papers in English for the benefit of the United States is simply not the responsibility of the Japanese. It is our responsibility.

Fortunately, in our case, the need for translation had been recognized. The panel's proposal was implemented and selected recommendations for translations had been made.

Acquisition of the materials was then our next step. I had supposed that major university libraries would be well supplied. My university in Japan carried all of the journals of the major American engineering societies. I could assign articles from the Journal of the Society of Mechanical Engineers, for example, and my students would have had no trouble obtaining those journals in English.

In my own translation work, I had little difficulty acquiring materials from the United States as Japanese libraries and bookstores had years of experience in such matters, and were able to obtain materials expeditiously, although not without some expense. This expense, however, is treated as a normal academic expense and, in fact, each faculty member at the Japanese university at which I was a member, is allowed approximately $1,500 per year to purchase materials for his or her own personal research.

However, in the United States, to my amazement, I found that with the notable exception of the Library of Congress, there was practically nothing available in any scientific field in the original Japanese in either libraries of major universities or corporations.

It is invariably a question of the best allocation of resources. Libraries cannot afford to purchase materials for the extremely small audience of scientitsts who read Japanese. Had we not had the overwhelming support and cooperation of the Library of Congress, our own work would have come to a standstill until we had purchased journals that we needed directly from Japan.

Our project, as far as we have been able to ascertain, is a unique university translation project. We have learned that the translation of technical Japanese anywhere in the United States, when done by private agencies, is on a haphazard basis. There seem to be very few individuals who are able to do this type of work because, again, so few Americans can speak, let alone read Japanese.

The key to this, then, is language. The severe shortage of information coming in from Japan has not been recognized because so few American scientists can read the original Japanese. The best journals cannot be identified because Americans have had so little experience with them. Libraries do not acquire scientific journals in Japanese because, again, so few Americans will read them. There is little translation work being done because there are so few people who can do it.

Unless we recognize that we must develop expertise in Japanese among even a small minority of American scientists and engineers, we will be cutting off unnecessarily important channels of information, crucial channels of information.

However, universities do not teach Japanese because it generally must justify its existence by steady enrollment; nevertheless, science majors have not been given either encouragement or the incentive to enroll and, therefore, to study Japanese.

The Computer Science Department at New York University decided that the only way to break this cycle was to encourage the reinstatement—and I add reinstatement because Japanese had been dropped from New York University's curriculum—of Japanese in the curriculum.

The interest shown by computer science majors was phenomenal and as a result, 48 percent of the first-year elementary Japanese students are computer science majors. They are highly motivated and successful with the language. Eighty-two percent of the entire first-year elementary class is not taking Japanese for its language requirement but purely as an elective; and 70 percent of our elementary class are not history or literature majors at all.

But then the Computer Science Department decided that the only way to encourage this program was to propose a 3-year program of technical Japanese, coordinated throughout the 3 years. And this the university accepted.

The time has come to give our full support to projects which will never attract people by the thousands but, instead, may attract some of our best, brightest, and most farsighted young people.

Chairman Walgren, honorable members of the subcommittee, it is our hope that you will join with us to urge the support and funding required for such projects.

We urge support of the National Bureau of Standards' programs to continue translation and promote language instruction.

We urge support of the enhancement of the Library of Congress efforts to gather materials and of the development of other library collections across the country.

And, three, we urge the support of language instruction with the scientist in mind.

Increased personal contacts with Japanese and information from Japan can only be of benefit to the United States. If we limit ourselves by language, we will suffer from the same type of self-imposed isolation that our friends and allies, the Japanese, would certainly advise us to avoid.

Thank you very much for your attention.

[The prepared statement of Ms. Goldman follows:]

Japanese Technical Translation in the United States -- Remarks to the United States House of Representatives Subcommittee on Science, Research and Technology

by Susan Goldman
Research Scientist
Courant Institute of Mathematical Sciences
New York University

Chairman Walgren, Honorable Members of the Subcommittee, Ladies and Gentlemen, on behalf of New York University, I wish to express my deep appreciation for having been given this opportunity to testify before you today.

At present, New York University is involved in a translation program which is an outgrowth of the conclusions of a fact-finding panel. The panel began its work under the direction of Dr. Carl Hammer, and is now headed by Professor Michael Harrison of the University of California at Berkeley. The program is currently funded by the National Bureau of Standards of the Department of Commerce in order to provide selective translation of Japanese papers in computer science on a continuing basis.

We hope that the Japanese technical translation project at the Courant Institute of Mathematical Sciences, New York University will encourage the development of other such programs at universities throughout the United States. Although the project is still new, we feel that it is important that projects of this type be given early recognition so that other similar efforts can begin as early as possible. This would prevent further delays in the acquisition, translation and utilization of Japanese scientific and technical information which could have undesirable consequences for the technological position of the United States.

During the past eighteen months, we have been able to identify the problems inherent in the development of technical translation programs; briefly outlined below:

1. Because of the rapid progress being made in the field, US computer scientists need more information on the state of computer science and technology in Japan. However, the small amount of information available in English is not current, does not appear regularly and is not readily accessible to most American computer scientists.
2. There has been no systematic attempt at any level within the government, industry or the university community to translate Japanese technical literature into English for public use. This is true not only in the case of computer science, but for all scientific and technical areas.
3. The literature most suitable for translation and the necessary Japanese reference works are extremely difficult to obtain. This is due primarily to the total lack of adequately-trained

specialists, and secondarily to the time and cost required, with the result that much material must be ordered directly from Japan.

4. The number of American technical specialists who can use the Japanese language in their professional work is virtually nil, nevertheless,

5. Universities are not working actively to remedy this situation by encouraging their science and engineering students to take Japanese as their foreign language requirement, and by offering programs in technical Japanese.

In the following statement, I will sketch the history of the New York University translation program, and then discuss its present activity and the reasons for the problems outlined above. Finally, I will make specific recommendations as to measures that could be taken.

I. A Brief History of the Japanese Technical Translation Project at the Courant Institute of Mathematical Sciences, New York University

The initial idea for this program came from a proposal prepared by the Computer Science and Technology Board of the National Research Council (NRC) funded by the Office of Naval Research (ONR). This proposal culminated in a report entitled "International Developments in Computer Science (IDCS),"* which purported that:

"The most advanced work in computers is now being done in Japan...In computer science, the Japanese have come from a position of essentially no activity to second place in the world in twenty years. They now have half the number of computers as the United States, and their growth rate is double that of the United States...the computer industry is one of the strategic industries on which the Japanese hope to build their future."

In addition, the report made the recommendation that:

"Academic centers of expertise on Japanese computing should be established in the United States or in Japan. U.S. government funding should be provided to support these centers in the continuing review and analysis of Japanese activities...These centers should be encouraged to interact with Japanese organizations such as the Japan Information Processing Development Center (JIPDEC)...The existence of these centers should be advertised in American computer journals and computer scientists should be encouraged to use the facilities."

*Quoted from "International Developments in Computer Science," prepared by the National Research Council, and published by the National Academy Press, (Washington, D.C., 1982), pp. ix-xi, 1-38).

These recommendations were first implemented at New York University due largely to the personal interest taken by Professor Jacob T. Schwartz of the Courant Institute of Mathematical Sciences, who was serving as Chairman of NRC's Computer Science and Technology Board. Professor Schwartz took the initiative to recruit the technical translator who was given the responsibility of organizing the project and to commence the translations. Funding was provided by the National Bureau of Standards through the National Academy of Sciences.

Our work concentrates in the translation of Japanese technical materials in the area of computer science. We have found that in addition to its overt content, the translation of even a single article of a Japanese technical journal provides valuable supplementary information including:

1. Summaries of past work in Japan, and work being done in other countries,
2. Information about the next generation of specialists,
3. Biographical data,
4. Bibliographies suggesting the extent of cooperation with American or European researchers and of information coming to Japan from abroad.

In the light of 1) the difficulties of Japanese technical translation, and 2) the insufficient level of such activity in the United States at this time, it is important to realize the Japanese, on the other hand, have long understood the dangers of becoming isolated from outside research. The home offices of all major Japanese firms require their offices in the United States to monitor American academic journals, newspapers and periodicals for anything of scientific or economic interest. Reports are sent on a continual, periodic basis.

II. The Work of the New York University Translation Project, the Problems of Identifying and Acquiring Suitable Materials and of Preparing Useful Translations

In order to begin translations on a steady basis, the first problems faced by any project are the identification and then acquisition of the literature to be translated, and at the same time, the procurement of dictionaries and basic technical reference materials. The Computer Science and Technology Board had provided recommendations as to the journals most suitable for translation, but merely the seemingly routine step of acquiring the literature and reference works began to reveal how ill-equipped the United States is to utilize technical information in Japanese.

Even in New York City, only two bookstores stock Japanese books and popular periodicals in technical subjects, and universities with large East Asian and Computer Science Departments prove to be poor sources of Japanese technical materials. A number of large universities have well-organized Japanese collections in their East Asian departments, and extensive technical materials in their Engineering departments, but the latter includes virtually no technical literature in the original language. Moreover, when there are substantial numbers of students from Japan enrolled in the undergraduate and graduate divisions in scientific and technical fields, there is almost no systematic attempt to acquire the journals of even the major Japanese academic societies -- the stated reason being that there are no librarians in the Engineering Library who can read Japanese and no engineers in the East Asian Library.

This partly explains why the universities best known for Asian studies are not necessarily the best candidates for the centers proposed in the IDCS report. The major departments of Japanese studies were organized at a time when there "was essentially no (Japanese) activity in computer science." Their scholarly collections focus entirely on the humanities, and their philosophy and personnel mirror this traditional emphasis. Therefore, the fact that a university has thriving departments in Japanese and computer science does not mean that these two departments can be merged or even coordinated with ease.

Next, the possibility of obtaining materials from major industrial firms was examined. Here too, the results were disappointing; the journals available in the largest collection turned out to be those the Japanese sent in exchange for company publications they sought to acquire, and these mostly consisted of public relations brochures written in English.

The only important journals translated into English and which appear on a regular basis are "Electronics and Communications in Japan" which consists of selected translations from the "Transactions of the Institute of Electrical Engineers of Japan," and "Systems, Computers, Controls" which consists of selected translations from the "Transactions of the Institute of Electronics and Communications Engineers of Japan," both published in the United States by Scripta Publishing Company. In the first case, few of the articles are of interest to computer scientists, leaving only one computer science journal. The English translations of these journals appear approximately a year and a half after the original journals have appeared in Japan. This delay is aggravated by the minimum of one year required for Japanese academic societies to review, edit and publish them. It should be noted that approximately one-half of the original articles are not translated, leaving open the question of how articles are chosen for translation or omission. There is the danger that articles of major interest to the United States are excluded.

Though several U.S. publishers -- Tuttle and Weatherhill -- devote considerable effort to Japanese translations, their material is almost exclusively restricted to the humanities. Thus, Scripta, which also translates journals from the Soviet Union, appears to be the only publishing company in the United States which regularly translates portions of any Japanese technical journals.

The most extensive collection of Japanese technical materials available in the United States seems to be that of the Library of Congress. Its Japanese Section has 16,000 periodicals covering all subjects, including several hundred in computer science, its theoretical base and practical applications, and those of its allied fields -- electronics, electrical and mechanical engineering, and robotics. The Japanese periodicals and technical journals of the collection are received mostly as a result of formal exchanges with Japanese libraries and purchases from Japan. The Japanese staff of the Library of Congress is extremely knowledgeable and cooperative, as is the staff of the Science and Technology Division, but both divisions lack the funds to hire personnel with the required expertise in relevant scientific areas to bridge the gap between Japanese and science/technology. This has prevented systematic cross-cataloguing of the materials in the two divisions. As a result, the Science and Technology Division catalogues of the scientific and technical holdings contained in the Japanese collection are sometimes incomplete or misleading, as they cover only those journals whose titles, when literally translated, contain language which clearly suggests science or technology. To cite an example, a major journal, "Hitachi Hyoron," literally translates as "Hitachi Review." This journal is excluded from the science and technology list, although it is in fact a review by Hitachi staff members of major technical and scientific research projects within Hitachi's various divisions and of university-sponsored research undertaken jointly with Hitachi staff. These problems in using the Japanese language catalogues in the Library of Congress imply that a researcher wishing to make comprehensive use of these materials must be able to check journal titles in Japanese and have enough knowledge of the Japanese scientific world to recognize which titles are pertinent. It would not be an exaggeration to say that a Japanese-English language compilation of the scientific and technical periodicals in the Japanese Division in the Library of Congress, with annotations as to general content, is absolutely essential, but it would require substantial investments in time and money. Referencing such a catalogue is the first stage in any translation project in any area.

The difficulties noted above are compounded at most university libraries. The traditional bias in favor of the humanities is complicated by cutbacks in funding which prevent the acquisition of technical materials and the specialized personnel needed to process them.

As the first stage of our project, translations were made of the tables of contents from Joho Shori (the Journal of the Information Processing Society of Japan) for each of the issues of 1982 and 1983, as we obtained them. Joho Shori has been judged by both Japanese and American scholars to have the greatest potential for articles of importance. It is the major computer science journal in Japan, roughly equivalent to the sum total of the journals produced by the Association for Computing Machinery (ACM) in the United States. Nevertheless, it is unobtainable, with the notable exception of the Library of Congress. The only way to obtain this journal is to apply for membership -- the acceptance of which is based upon professional credentials and the personal recommendation of a member of the society. Joining each academic society would hardly be a feasible solution for the individual computer scientist who wished to look over a number of the more important Japanese journals, even were he/she able to read them. As our aim is the dissemination of as much information as possible, we feel that the more important journals need to be made available at various libraries across the country.

The translated tables of contents were presented to various scholars who selected the articles for translation. Note again that titles alone may not contain enough information to guide even the informed scientist. Furthermore, Japanese scholarly articles often lack summaries or abstracts which would provide more concrete clues. As an example, one article that was recently translated is entitled, "Compiler

Generators." The paper is actually a broad survey of the present state of the art of compiler technology, plus some historical information, but whether this information is useful to the American reader cannot be ascertained from the title alone, any more than an article entitled, "Viruses," would necessarily be new or of import to a specialist in virology.

Despite the various complications, we have made continual progress with translations, mostly from Joho Shori, and have distributed them to all interested individuals and groups. The topics covered include compiler technology, software engineering and Ada, a high-level computer programming language.

The second aspect of the program, which will be discussed in Section IV, began as a result of the discovery that there were almost no science students being trained in technical Japanese at universities throughout the United States. As long as future generations of scientists are unable to read articles in the original Japanese, translations continue to be essential, despite the time-consuming and costly nature of this work.

There is no coordinated attempt in the United States (or elsewhere, with the possible exclusion of the People's Republic of China) to prepare translations of Japanese technical materials of potential relevance to researchers in the government, industry and in the academic community. Several private translation agencies do handle Japanese on request from private individuals or organizations, but there is at present no coordinated effort comparable to the well-established Russian translation activity of the American Mathematical Society (AMS). The Society has sustained a thirty-five year project to translate Russian mathematics journals, which began with a grant from ONR in 1948, but eventually become self-supporting. The program represents a useful model for a similar type of translation project for Japanese computer science.

Dr. Silver of AMS considers technical competence of the translator to be the major factor--in determining whether a translation is successful or not. Complete literacy is also essential, and this, of course, raises problems that are compounded in the case of languages such as Chinese or Japanese which do not use simple alphabets. He observed that despite his own mathematical proficiency and long experience with Russian translations, an attempt to translate Chinese mathematics papers by working together with a professor of Chinese literature was totally unsuccessful. Dr. Silver also noted that the AMS has found that native speakers of English produce translations of the highest quality.

The problems of Japanese translation are far more severe than the problems that the AMS Russian project has had to face and overcome. Since few Americans can read Japanese, assembling committees to select articles for translation proves extremely difficult. As mentioned, abstracts are usually missing from Japanese articles and since the language is almost impossible to skim, one must often read an entire article in order to determine whether it is worth reading! Students in the United States do not study "Scientific Japanese" as doctoral students in the sciences routinely study Russian, French and/or German. For this reason, nearly all American translation agencies are forced to rely on Japanese native speakers, who are generally not technical experts. They then have Americans, who are not professional scientists either, edit the English prose. This two-step process often takes the translation even further away from the intent of the original author. Dr. Silver found that it never worked for Russian; it could hardly work any better for Japanese, and in fact, it does not.

Our most significant finding with respect to the articles we have translated is that the level of research in computer science in Japan is comparable to that of the United States, and in certain specific areas may be higher. Japanese research is strengthened by extensive and effective cooperation between government and industry in Japan, even though hampered by poor communication and/or coordination among the research teams of different universities.

III. The Pilot Program in Technical Japanese Instruction at New York University

The problems of technical translation reviewed above make it plain that the United States cannot hope to keep up with the increasing stream of important Japanese technical documents unless the number of Americans proficient in technical Japanese is greatly increased. Japanese, however, is a difficult language to learn, even for the Japanese themselves, who, in view of the non-alphabetic nature of the language, typically do not become completely literate before reaching high school. For American students of Japanese, this inherent difficulty is compounded by many factors, one of which is the ambivalence shown by many universities towards language instruction. Universities tend to be very cautious about adding new languages to their curricula. When the enrollment in a language drops, the language may lose its budget line, and all courses in it will then be eliminated. In terms of funding, it should be observed that language instruction occupies a peculiar position. Were students to arbitrarily decide that they were no longer interested in studying biology, and enrollment dropped sharply as a result, it is, nevertheless, difficult to imagine any university deciding to drop biology from the curriculum. Unfortunately, universities fail to recognize that languages are actually tools, and that any language can become the vehicle by which one can study science or history, just as English serves as the language of instruction in the United States. The climate generated by the lack of sensitivity to the importance of a particular language leads to wide variation in the enrollment of science students in language courses from year to year. The combined problem of funding based on enrollment and insensitivity to the increasing nation-wide need for specialists competent in the less "popular" languages has created the present situation -- a nearly total lack of science and engineering professionals with even a rudimentary knowledge of Japanese.

Although the number of universities offering Japanese for credit is relatively small, even Professor Eleanor Jorden, President of the Association of Teachers of Japanese, has no accurate statistics on either the number of universities which offer Japanese in any type of program or the number of students currently enrolled in Japanese language courses. One study compiled several years ago estimated total enrollment (over all levels) of roughly 11,000, the greater percentage of which can be assumed to be in the humanities. In contrast, there are reportedly over one thousand students presently studying Japanese at the École des Langues Orientales in Paris alone.

As a small contribution to alleviate of this very unsatisfactory situation, the Computer Science Department at New York University, has recently embarked on an experiment to teach computer science majors Japanese. This type of project appears to be unique. Therefore, we will review some of its details in the hope that other universities may find it worth emulating and improving upon. Since we believe efforts of this type are important for the future of computer science research in the United States, we hope that both federal and private funds will be forthcoming.

In March 1983, we invited computer science majors to consider taking Japanese as their foreign language. It was hoped that this course would draw a large number of sophomores who would be able to continue the study of Japanese for at least three years. This would enable them to move towards a technical focus by the beginning of their second year. The program was designed for undergraduates because younger students seem to do better with the language, and because graduate students have various pre-professional obligations and usually cannot attend a class which meets four days a week. Nevertheless, several graduate students from the Department of Computer Science have requested permission to enroll. There are now thirty-four students in the second term of Elementary Japanese: 13 (38%) are computer science majors, 5 (14%) major in science or engineering and 5 (14%) in business administration/economics.

Our fledgling program aims to meet the needs of computer science / business / technology majors who have chosen Japanese as their foreign language. Features of our program shaped by this philosophy are given in Appendix I. Reactions of computer science students enrolled in the program are quoted in Appendix II, and indicate that there are psychological and cultural, as well as grammatical difficulties. Technical Japanese, however, may actually be easier to learn than literary Japanese. The technical style of writing is much less complex, and because it is free of social constraints and rules, the grammar can ignore complicated conjugations and verb structures. The vocabulary becomes workable due to the limitations of the subject under discussion. Were such programs in technical Japanese to receive ample publicity in conjunction with sufficient funding to allow them to become established, we believe that they would become both popular and successful. Our program demonstrates its success by extremely low rates of student attrition and absenteeism, and high examination scores.

Technical Japanese requires curricular materials which are not currently available. In the type of program that New York University is working to build, the instructor is forced to use several textbooks at the same time. There is no single textbook designed for students who aim in their second year to work with modern texts such as newspaper articles, and plan to go on to read technical materials. The only textbook which attempts to teach technical Japanese is "Comprehending Technical Japanese" by Edward E. Daub, R. Byron Bird and Nobuo Inoue (Tokyo: University of Wisconsin Press/University of Tokyo Press, 1975). Its stated aim is "to provide the means for courageous scientists or engineers to learn to read technical Japanese by hard work." Three of these "courageous" students are currently enrolled for the first time in a credit course in second year technical Japanese. The textbook assumes that students have had a year of Japanese, despite the fact that most of the first-year programs would not provide a student with the preparation necessary for the rigorous written materials it presents. While applauding the second year course in technical Japanese offered by the University of Wisconsin, it is our feeling that a program very carefully coordinated throughout the entire three years is absolutely necessary for a mastery of technical Japanese. Unfortunately, most first-year textbooks do not use the Japanese writing system but instead rely on a romanized alphabet to help students pronounce the words aloud. This prevents the development of reading skills and makes it difficult for students to retain new vocabulary words, use dictionaries, or practice writing, rendering it impossible for any student to use the above textbook after only one year of Japanese. To develop curriculum and the related textbooks, adequate funding is essential.

IV. Some Thoughts on the Rapid Progress Japan has Made in Science and Technology

I have had the experience of returning to the United States after more than a decade in Japan, spent as a graduate student at Kyoto University and then as a faculty member at Osaka Institute of Technology, and with your permission, would like to note several striking contrasts between Japanese and American society in general, and university life in particular. These may bear on the problem facing the United States as it strives to maintain its competitive edge in computer science in particular and technology in general.

The Japanese educational system pays enormous attention to mathematics and science at all educational levels. This concentration is eased by a total absence of the myth current in the United States, especially among certain minority groups, that mathematics and physics are difficult to learn. Japanese do not express the belief that these subjects -- including mathematics through Calculus -- are difficult to learn for any subgroup within the population. If anything, Japanese believe that languages, and English in particular, are the backbreakers. This attitude towards mathematics plus the employment of mathematics graduates in elementary schools helps the Japanese sustain high levels of mathematics instruction at extremely early stages in elementary education. This observation is validated by the small comparative study I have made of mathematics education as it exists in high schools in the United States, Japan and the U.S.S.R. (Appendix III), which demonstrates that by the time they reach high school, Japanese and

Russian students are already considerably ahead of their American peers.

The number of students in university engineering courses in Japan has increased gradually over the past decade. There are so many graduate students who wish to teach at the college level, that there are not enough university positions for the majority of them. Japanese salaries in industry are roughly equivalent to those in the academic community, university life offers considerably greater personal freedom. This contrasts with the situation in many American universities, where foreign engineers with doctorates are increasingly relied upon to fill academic positions as more and more American graduate students are being lured away by industry.

The Japanese effort in English language instruction is colossal compared to the United States effort in Japanese. For many years, English has been compulsory in Japan from ninth grade through high school, with at least two additional years at the university level. All universities require at least one foreign language, in nearly all cases English, and many require a year of a second language usually French or German, much more rarely Chinese or Russian. Since the Meiji Restoration (1868) when Japan officially became open to Western science and technology, it has been routine for Japanese academics working in any area to translate and circulate all books, papers and research materials from the United States as they become available. This allows them to learn from, and perhaps improve upon, foreign ideas and developments as quickly as possible. This is, in effect, what happened in the field of computer science after World War II.

Recommendations

- The above remarks, I believe, are quite clear and speak for themselves.

I would like to conclude simply with the following recommendations:

1. The work of the National Research Council presently funded by the National Bureau of Standards should be given the Committee's strong support since the NRC has been the pioneer in encouraging officially-supported Japanese technical translation.

2. Beginning with the Library of Congress, research libraries should be given the financial support necessary to obtain materials from Japan and to hire and train qualified specialists who can bridge the gap between science/technology and Japanese.

3. Universities should be given funds for instruction in technical Japanese with reasonable allowances made for the time required to develop materials and programs, and to build up enrollments.

4. Financial aid should be given to science students willing to undertake the added burden of a minor in Japanese.

Appendix I -- The Philosophy Behind the Japanese Language Program for Science and Technology Majors

1. In the first two weeks of the year, students are expected to learn the hiragana syllabary on their own. Following this, they are introduced to the spoken language. They are required to write in Japanese everything they can say. Kanji ("Chinese characters") are introduced, at the rate of approximately ten per week. Characters are carefully chosen to reflect basic words and concepts taken from the students' increasing oral vocabulary, to ensure maximum visual and oral exposure. By the end of the first term, students are expected to read and write the equivalent of those kanji required of Japanese first-graders (with some additions of a number of more advanced kanji and some omissions based on relative frequency and importance).

2. Verb patterns and word order study are structured to allow the students maximum communication which gives further personal reinforcement. Given that the university is located in New York City, it is possible for students to interact with native Japanese and to attend a wide variety of events, ranging from lectures on scientific exchanges with Japan to classical theatrical productions. During intersession, students are required to memorize the katakana syllabary, which is used for the foreign loan words with which Japanese abounds. Students report that the initial decoding process has become considerably easier and that the more configurations they learn, the easier it becomes. The focus of the second semester of instruction, which has just now begun, will be on speaking and reading increasingly complex sentences.

3. Our plan for second year Japanese is to develop skills readily enough to enable the students to read newspapers by the second semester. This requires that they be first instructed in the use of dictionaries, which are structured in terms of visual configurations based on the original meanings of the Chinese picture-forms from which they developed. This, in turn, requires an understanding of the order of pen (or brush strokes) and the ability to count them, considerations which appear to the novice to be based on no logical principles whatsoever. However, once this difficulty is overcome students will be able in their third year to read modern Japanese texts in technical areas.

Appendix II. The Difficulties involved in Learning Japanese Reported by Computer Science Students at New York University

The following excerpts from student comments illustrate some of the difficulties encountered in Japanese study. They represent student responses to the question:

"Do any features about Japanese make it a difficult language to learn ?"

Roman numerals refer to individual answers.

I -- Japanese has absolutely no relationship to English except for the katakana syllabary which serves to "Japanize" foreign terms. The syntax and grammar of Japanese are drastically different from that of English. In most cases, the verb is placed at the very end of the sentence. Sometimes it seems that what we might consider a "subject" is missing or nowhere near its "verb."

II -- I have studied Japanese for almost two terms now, and I find Japanese very intriguing. Not only do I have to learn two syllabaries and thousands of figures, but I also have to learn a different frame of mind, a different philosophy on life. Although adapting to the different ways of thinking is difficult, it is not nearly as difficult as learning how to memorize these configurations.

III -- As a third generation Japanese-American who has been exposed to frequent situations during which the Japanese language is spoken, I anticipated few difficulties upon entering into my first year of a formal study of Japanese. The assurance which I felt, however, quickly disappeared as I grew to realize the importance of understanding the Japanese culture and its influence upon the language. Unlike Spanish which I studied for six years in high school, Japanese has strict levels of formality to which one must adhere in accordance with social situations. This is quite difficult as it involves both an analysis of the situation and the application of the appropriate level of formality to be used.

IV -- I have found various points difficult including:

1) Untranslatable idioms, especially those based on non-Western ideas.

2) Kanji--the actually difficulties in learning to write Chinese characters, the need to memorize stroke order and the varying pronunciations possible for each individual character and which depend on the context.

3) Word order -- verbs at the end of sentences, relative clauses preceding nouns.

Appendix III. Mathematics in Japanese High Schools

The Japanese system is far more standardized from school to school within the system and more crucially, students receive substantially more mathematics training than most of their American counterparts. To quantify this statement, I offer the following table which gives a comparative overview of the high school mathematics and science curricula in the United States, Japan and the U.S.S.R. Note that in the case of the U.S., the data reports New York City schools. All data are for academic high schools and represent the grade in which a subject is normally taken. Asterisks (*) indicate that the subject is commonly elected but not required.

a) Mathematics Education in High Schools in the U.S., Japan and the U.S.S.R.

	U.S.	Japan	U.S.S.R.
Years of formal education	12	12	10
Typical age at graduation	18	19	17
Mathematics (grade taken)			
Elementary Algebra	9	7-8	7
Plane Geometry	10	7,9	7-9
Intermediate Algebra and Trigonometry	11	10	8
Advanced Algebra	12*	11	9
Solid Geometry	12*	6,7,9	9-10
Calculus	12* or University 1-2 yr.	11-12	9-10
Science (grade taken)			
Biology	10	10	5-9
Chemistry	11*	11	6-9
Physics	12*	12*	6-10
Astronomy	--	--	10

b) Related Data on Classroom Environment

	U.S.	Japan	U.S.S.R.
Maximum Class Size	34	45-50	30+
School Days / wk.	5	5 1/2	6
Subject Periods /wk. -- Mathematics	5	5-6	6-7
Subject Periods / wk. -- Science	5-6	5	8-9
Minutes / period	40	40	45
Honors classes avail.			
-- Mathematics	Yes	No	No
-- Science	Depends on subject	No	No
Remedial classes avail.			
-- Mathematics	Yes	No	No
-- Science	No	No	No
Electives avail.			
-- Mathematics	Yes	No	No
-- Science	Yes	No	No
Teacher salaries (compared to those earned in industry)	Approximately 1/2	Almost equal	Slightly lower
Additional incentives	Long vacations. Union benefits may be better.	Forty days vacation vs. ten days in private industry.** Full civil service status -- bonuses, pensions, promotions based on seniority. Considerably less personal pressure. Equal treatment of women.	Two month vacations (vs. four weeks in industry).

**In the private sector, Japanese workers are rarely free to actually take their full number of vacation days.

Mr. **Walgren**. Thank you very much for that testimony.

Well, that's relatively specific and stark examples about where we are.

I wanted to ask Dr. Bartholomew, you indicated that relatively little of the overall literature was translated into English. Can you elaborate on that at all? Sometimes we hear that, well, gee, a lot of that stuff is translated into English.

Mr. **Bartholomew**. Well——

Mr. **Walgren**. What's your view of the overall?

Mr. **Bartholomew**. Tomorrow, you are going to have testimony, Mr. Walgren, from Bill Budington of the John Crerar Library in Chicago, and also from Bob Gibson from the General Motors Institute in Flint, Mich. And those two gentlemen can give the committee details about that.

Suffice it to say here that the Gibson study that was carried out in 1980 arrived at rather precise estimates of just how much of the Japanese literature appeared in English, field by field. And in general, for most fields, it's around 20 to 25 percent, at most, in English.

Now, Budington, at the John Crerar Library, has some connection with something called the National Translation Center. And that is an agency where corporations, almost entirely, pay an annual membership fee and can then use the translations that exist there of technical materials in foreign languages, including Japanese. And then they, if they commission themselves a translation, pay for it themselves. They deposit it there and then others can use it too.

The demand through the National Translation Center for the Japanese materials has been growing very substantially but, of course, it's a drop in the bucket as to what's really needed.

Mr. **Walgren**. You know, we often assume that the universities will be doing things that are necessary and——

Mr. **Bartholomew**. No, they are not——

Mr. **Walgren** [continuing]. Sufficient for our future needs.

Mr. **Bartholomew** [continuing]. Right now, they are not.

Mr. **Walgren**. And from the testimony today, then, clearly the MIT program is at least small——

Mr. **Bartholomew**. But it's unique.

Mr. **Walgren** [continuing]. And this one at the New York University, you are really starting from a very small base, if any. Is it true that in this area the universities are really behind industry?

Mr. **Bartholomew**. Yes, they are behind industry, substantially behind. I have, myself, called on the telephone a large number of university libraries, including university engineering libraries around the nation, and asked them whether they were purchasing and making available Japanese language, engineering and other science journals from Japan. And most are not doing so. Some very major ones that we think of as on the cutting edge of American scientific and technical research have indicated that they are not acquiring any Japanese journals whatsoever, that is, in Japanese language. And, moreover, they have no plans to do so at this time for the reasons that have been indicated here.

Mr. **Walgren**. That's a surprise to me, and I don't really know why it should be. I wonder whether others sort of instinctly assume that the universities are developing resources or capacities that they may want to rely on in the future; and in this instance if we are to turn to the universities we find that that has not been the case.

Mr. Bartholomew. It has not been.

Mr. Walgren. I'm sure the ways to change that are obvious, but what seems important is I think many in our society view universities as having the resources, and the time to think about what future needs are and to be somewhat self-directed. I think the idea that the universities are far behind industry would come as a real surprise to some people in industry, who would assume that the reverse is true.

Mr. Bartholomew. Now, the reason, of course, is that at least private sector firms have an immediate motivation to obtain at least some kinds of information from Japan. I mean, there is the question of profitability, and universities, needless to say, are not concerned with profit—at least not in the same way.

Mr. Walgren. Is it your experience that the universities are getting the English component of the Japanese——

Mr. Bartholomew. They are getting some——

Mr. Walgren. Components?

Mr. Bartholomew [continuing]. But, unhappily, the studies that Mr. Gibson's group conducted show that even with respect to the English language material the Japanese are putting out, the holdings of even that English material in the United States are very, very scanty and insufficient.

Dr. Westney?

Dr. Westney. If I might speak to that on two counts. I think you mentioned a very important point, that is, we assume that universities have the resources to do this. And, in fact, university library budgets are under steady pressures, partly because of the rising costs of acquisitions, which means that the constituencies that exist at the university for existing programs naturally have priority. And adding any new programs, new acquisitions, is inevitably going to take money away from somebody else. And that means that any attempts to push new programs, as we have found in a sense at MIT, MIT has more or less said that the electrical engineering and some of the other computer science-related departments would be very keen to have Japanese language at MIT oriented to their students. But if it's to come out of the language budget of MIT, there's no slack for that; there are no slack for resources.

This may sound self-interested but I would like to point out that the MIT—Japan science and technology program was set up by Dick Samuels as an extra on top of a full faculty load. I, myself, am carrying the administration this year on top of a full faculty load at the Sloan school with no time off, no extra salaries. This is a labor of love.

And to the extent that universities have produced people that have that kind of motivation, they have developed these kinds of programs, but on a shoestring. And now we are finding at MIT that industries—now that we are becoming more visible—companies are coming to us, industry people are coming to us, with needs that we cannot possibly fill on the resources we have. And they just assume that an institute like MIT will be producing the kind of people they need. It is a shock to them to find out that the resources are so slender.

Dr. **Westney**. They are contributing to help on a short-term basis. But it's still a problem.

Mr. **Walgren**. I wanted to underscore with interest your testimony, Ms. Goldman, that Japanese language had been phased out at New York University.

Ms. **Goldman**. Yes,——

Mr. **Walgren**. Is that right?

Ms. **Goldman**. It had been phased out because of insufficient enrollment. But, by the same token, the Engineering School had also been sold for financial reasons.

I would also like to speak to this question, however. The panel—the Computer Science and Technology Board panel—assumed that the best place to set up this kind of translation program would be at universities where there were both departments of East Asian studies and computer science, with the assumption that the East Asian libraries would have a full complement of technical materials.

At the major universities that I also have called and tried to survey on an individual basis, we have found that there is absolutely no bridge between the two areas. The scientists don't speak Japanese, and neither do their librarians in the science divisions, or the engineering division.

And the Japanese librarians were hired at a time when after the Second World War, the main interest was in Japanese culture. So they also have had a severe bias away from science.

And, consequently, you cannot find the most important journals in computer science in any major libraries.

Mr. **Walgren**. That's interesting.

It is my understanding that—is it the Courant Institute, is that correct?

Ms. **Goldman**. Yes.

Mr. **Walgren**. That they are conducting research in computer architecture; is that right?

Ms. **Goldman**. That's right.

Mr. **Walgren**. We understand that is at least basic to the development of the advances in computing speed that are thought to be coming.

Can you give us any feel for how the lack of access to translations could only impede the progress in that particular interest of that institute?

Ms. **Goldman**. Yes, I think I can answer that with a simple description. As I am sure you are all aware, there have been recent articles in the newspapers about the development of the high-speed computers, the supercomputers. We call them ultracomputers at NYU. Ultracomputers involve thousands of microprocessors and thousands of memory units which are connected, using powerful switching techniques. And what this allows is high-speed calculation for difficult problems—for one large difficult problem or for a number of small problems simultaneously; so that the problem can be solved with the most efficient speed.

And in the New York Times recently, there was an article announcing the development by Fujitsu and Hitachi of a new high-speed computer which was faster than any American computer so far. And the quote that I found most amusing was "that in a familiar technique, the Japanese borrowed American designs and improved them. Fujitsu has taken the best features of Cray, C.D.C., and IBM architectures and put them all together."

Now, obviously, the reason they were able to do this was mostly because they had read the research being done in computer architecture, translated it from English to Japanese, and worked upon it.

Had we been able to take the best features of Fujitsu architecture, many of which have been published in journals because they come from university work, and developed upon them, we would not be reduplicating their efforts; we would be building upon them, and improving them.

Mr. WALGREN. That's well said.

I was surprised, Dr. Westney, that your program for exchange students involves only six people. Is that right?

Dr. WESTNEY. That's right. This is our first year to send cohorts—to send a cohort of students off to Japan. And I would like to point out in view of the remarks that are made in the press, that one of the problems might be Japanese secretiveness, an unwillingness to cooperate; that we have more standing offers from Japanese private companies to take our student interns, than we have qualified students to take those up.

Mr. WALGREN. Is that right?

Dr. WESTNEY. The opportunities are there, we just don't have the qualified people.

Mr. WALGREN. And that at a university where we would expect a major effort in that area, we are seeing numbers like six——

Dr. WESTNEY. That's right, that's right.

I would also like to point out that our two students, one of whom is at Kyoto University working in a lab and the other is at Tokyo University working in a lab; both are on Japanese Government scholarships from the Ministry of Education; not U.S. Government scholarships.

The students who are working in the private companies have all their expenses paid by the Japanese companies, including a salary and stipend.

We have not, so far, and this is starting to change; but, so far, we have not received any direct U.S. Government or industry support in this effort. The support has come from Japan.

Mr. WALGREN. I see.

Mr. BARTHOLOMEW. The people who accuse the Japanese of always trying to keep our American products and not playing fair should keep this in mind: the Japanese are in fact trying to help us now access their own information. We might consider doing something to help ourselves, too.

Mr. WALGREN. Good point.

Ms. Bach?

Ms. BACH. Dr. Westney, how aggressive have you been in seeking either Federal or private support from our——

Dr. WESTNEY. We——

Ms. **Bach**. United States?

Dr. **Westney**. We have been fairly aggressive in seeking private support, and that is starting to materialize. Both Eastman Kodak and Motorola have agreed to underwrite part of our program for the coming years, and we have several more companies who are coming onboard. So that is starting to change.

But I made the point less to show that there wasn't the resource base in America than to show the willingness of the Japanese to provide the seeding for the program.

Ms. **Bach**. What have you done with Federal moneys, or attempts to obtain Federal moneys?

Dr. **Westney**. We have been talking with several of the Government agencies about MIT undertaking part of, or the whole of, some kind of coordinating role.

One of the recommendations that came out of the Endicott House meeting, which many of the people who are testifying here at the hearings attended, was that MIT should, in the absence of any other sort of central coordinating function, continue to have meetings, continue to bring people together, and should seek some kind of Government funding to do so.

The Office of Naval Research, the National Science Foundation, and NTIS, all express some willingness to provide the money, but nothing has yet materialized in spite of continuing phone calls, and I think it's partly just budget problems and the fact that there aren't slack resources. But even something to carry that kind of coordinating role has not materialized despite very strong moral support.

Ms. **Bach**. Thank you.

Mr. **Walgren**. Thank you very much.

Well, on behalf of the committee, let me thank you all for your testimony. We have enjoyed it and look forward to working with other Members and staffs, in hopes of making some contribution in this area. So thank you very much for being a resource to the committee.

Dr. **Westney**. Thank you.

Mr. **Walgren**. The last panel, grouping together, Dr. Bruce Merrifield, the Assistant Secretary for Productivity, Technology and Innovation with the Department of Commerce, welcome, Dr. Merrifield. For those of you who may not know Dr. Merrifield, he has responsibility for the National Technical Information Service on this level and is a frequent witness before this committee and others interested in innovation and the contribution that the Department of Commerce must make in that area.

Dr. Merrifield is accompanied by George Mu, the Deputy Director of the Office of Japan International Trade Administration with the U.S. Department of Commerce.

And also asked to join with this group, David Shonyo, the Acting Director of International Affairs for the National Technical Information Service, accompanied by Dr. Joseph Caponio, who is the Director of the NTIS, as I understand the relationships.

Well, welcome to the committee and I apologize for our running a little late. I always feel a little badly when Dr. Merrifield has to wait to take his turn, yet on the one hand, I always feel that the—the more testimony that administration people see, the better off we all are. And I know in Dr. Merrifield's instance it is a real interest to him. So I know that—that at least we haven't abused your patience, and I appreciate that.

Let's start then with Dr. Merrifield and then continue on with Mr. Shonyo.

Dr. Merrifield.

STATEMENTS OF DR. D. BRUCE MERRIFIELD, ASSISTANT SECRETARY FOR PRODUCTIVITY, TECHNOLOGY AND INNOVATION, U.S. DEPARTMENT OF COMMERCE, ACCOMPANIED BY GEORGE MU, DEPUTY DIRECTOR, OFFICE OF JAPAN, INTERNATIONAL TRADE ADMINISTATION, U.S. DEPARTMENT OF COMMERCE; AND DAVID B. SHONYO, ACTING DIRECTOR, OFFICE OF INTERNATIONAL AFFAIRS, NATIONAL TECHNICAL INFORMATION SERVICE, ACCOMPANIED BY JOSEPH E. CAPONIO, DIRECTOR, NATIONAL TECHNICAL INFORMATION SERVICE

Dr. MERRIFIELD. Well, thank you, Mr. Chairman. I do appreciate this opportunity to testify. It is an area of very significant interest to me. And I would like to have my prepared comments entered in the record and——

Mr. WALGREN. Thus they will be.

Dr. MERRIFIELD. Thank you.

Later David Shonyo will have a—his testimony as well, and then all of us will answer any questions.

I think I can summarize my comments by again pointing out that the industrial world really is now largely driven by technology. It's a worldwide phenomenon with a tremendous explosion of technology. The U.S. share of the world's technology has dropped from about 70 percent a decade ago to 50 percent now and perhaps a third in another decade. Good ideas now don't care where they come from and they will continuously come from almost anyplace and it will be critical, therefore, to continuously scan the world technology if any ind—university or industry in this country expects to maintain competitiveness in these world situations.

The life cycles and products and processes are telescoping rapidly; electronics, it's 3 to 5 years now; and 5 to 10 years in most other things; continuous obsolescence of skills and products and processes as new things take their places.

The U.S. share is down. The urgent need, then, is to continuously scan this wildly moving world of technology. And, of course, in the United States, we have very significant motivations to publish most of the—whatever we discover. The publish or perish dictum in the universities gets most of that out in the public literature. Our patent laws also are designed to encourage industrial work to be published and returned for patent protection.

So that most of the work we do in this country really does get into the—into the literature. In fact, we—we, therefore, have fueled, and will continue to fuel much of the world's technology as a result.

Of course, as was pointed out, in Japan it is not that way, much of the 80 percent, or thereabouts, the technology that's developed is in industrial laboratories where it's reported in internal reports but doesn't see the public literature and that's a critical problem.

There are a number of steps that are necessary in accessing that information. The first really is the negotiations for acquisition of the technology. As George will point out in a little bit in his testimony, the NTIS has been negotiating with individual companies and industry associations to acquire that technology.

Now, the second step, then, is to—is to scan is to really to ab—to screen it for industrial importance or significance or theoretical significance, and then to abstract that and translate it. And then once it's been translated, of course, it can be put into the NTIS data base which is the world's largest data base on line with all the other great data bases here, and for dissemination. And then, of course, we have the Center for Utilization of Federal Technology cuffed in NTIS, which is designed to try to disseminate that information in industrially useful packages.

So we have a—we have the incipient apparatus here in many ways but the slow steps in this process really are the initial acquisition—negotiation for acquisition of the information, and then the translation.

The translation, of course, is a costly process and what I am hopeful that we can do is to incorporate this into the R&D limited partnership concepts as we build those. Of course, the antitrust laws have inhibited the formation of the big ones up to date, but if we get the antitrust law—antitrust legislation, I think we can expect a rather significant increase in those, like the Semiconductor Industry Association which is now targeting the four megabit chip. And in the context of those limited partnerships, we can share, through the private sep—through private sector funding, the critical translation efforts that I think that are necessary. And that's what our agenda is, what we are trying to do. And—but that's a generalized picture of it.

Of course, again, just to emphasize the importance of this, the recent piece of intelligence that came to me—it turns out that the Japanese now have developed a semiconductor that's twice as fast as the galimarcinad (phonetic) semiconductor. Of course, that's a big step toward the fifth generation computer. You have targeting robotics, of course, and satellite communications, and engineering plastics, and those advanced technologies, particularly in biotechnology, for example, where it turns out that the economics of that are in the process in permutation—the permutation and purification technologies which are process technologies where we've made very little focus so far.

Again, we need to stay abreast of all of these developments. I could go into hundreds of these examples but I think it's awfully critical now that we begin to access more effectively what's really going on, not only in the Japanese world but also progressively this will be a problem in other—many other areas as well.

Thank you.

[The prepared statement of Dr. Merrifield follows:]

U.S. Department of Commerce
Statement of
D. Bruce Merrifield, Assistant Secretary
for Productivity, Technology and Innovation
Before the Subcommittee
on Science, Research, and Technology
Committee on Science and Technology
U.S. House of Representatives

March 6, 1984

Mr. Chairman, I appreciate this opportunity to appear before the Subcommittee on Science, Research and Technology in connection with these important hearings on Japanese scientific and technical information, and on possible actions to increase U.S. industry's access to it.

I am accompanied today by Mr. David Shonyo, Acting Director of International Affairs for our National Technical Information Service. Mr. Shonyo, who has a prepared statement of his own, will discuss NTIS's activities in seeking Japanese science and technology literature for U.S. consumers of it. Also with me is Mr. George Mu, Deputy Director of the Office of Japan, of our International Trade Administration (ITA). Mr. Mu is prepared to answer questions on the $500,000 program Commerce and the National Science Foundation are funding to evaluate Japanese technological strengths in four selected industries: computer science, mechatronics, nonsilicone-based microelectronics and biotechnology. ITA has detailed this program, and other activities, in a separate statement submitted for the record.

I would like to begin with a few general observations.

First, I believe that it is vital to establish strengthened mechanisms for monitoring worldwide industrial nation advances in technological innovation. About 90 percent of all scientific knowledge has been generated in the last 30 years. This pool will double again in the next 10 to 15 years. Ninety percent of all the scientists who have ever lived are living and working now; their number will double again in that period. Technology explosions will continue to occur in such fields as electronics, communications, engineering, plastics, biogenetics, specialty chemicals, pharmaceuticals and so on. Advances will be so rapid that some products and processes will be rendered obsolete while still in the development stage.

Ten years ago the United States, with only five percent of the world's population, was generating about seventy five percent of the world's technology. Now, the United States share is much less because of growing contributions made by countries like Japan. In another decade, our share may approximate only thirty percent.

On the R&D front, Japanese R&D spending in 1981 exceeded $26 billion annually--four times more than ten years earlier. By contrast, civilian R&D for the United States in 1981 approximated $52 billion, putting Japan at close to parity with us on a per capita basis. It should also be noted that Japan spends relatively little on military R&D, while a large percentage of the U.S. Government's R&D budget is defense-related. Therefore, we can no longer afford to indulge ourselves in a myopic, "not invented here" reluctance to avail ourselves of Japan's superior know-how in some fields.

Although the U.S. overall trade balance in high technology products increased from 1962 through 1980, Japanese, German, and French balances also grew. Even though the U.S. surplus remained the largest, the relative growth in the Japanese surplus was the most rapid. Yet, in the 1960s and '70s the United States lost market share in high tech products. Further, our high technology trade surplus is substantially attributable to only two industries: aircraft and computers.

The dramatic change in the Japanese competitive position in high technology is indicated by its expanding bilateral balance with the United States in this area. From a deficit in these products in 1968, Japan moved to a surplus position vis-a-vis the United States of nearly $3.0 billion in 1980. This surplus--about one seventh of Japan's global high technology trade surplus--was about equal to the U.S. combined surplus in these products with France and Germany.

I would like to turn now to certain particular industries.

Computer Hardware and Software. For the present, the United States retains leadership in computer hardware and software technology and production, but the Japanese have begun to close the gap. For example, Japanese producers now have products that match or exceed the capabilities of major U.S. producers in such sectors as large-scale processors and magnetic disk storage and printers. Japan's government-industry research efforts are focusing on software. Japan's fifth generation computer project is a major attempt to establish the Japanese computer industry as the world leader by the 1990s. Although the project may not meet its objectives precisely, key advances will result, yielding commercially competitive products well before the end of this decade.

Beyond their major fifth generation computer effort, the Japanese have a variety of other important computer projects, the results of which will substantially affect the U.S. computer industry commercially in the future. Their work in supercomputers, for example, is designed to place them ahead of U.S. suppliers.

Semiconductors. The United States no longer has the lead in several important areas of semiconductor technology. Japan has an emerging leadership role in metal-oxide semiconductor high-density computer memories. It now has well over 50 percent of the world market for the current state-of-the-art device. The Japanese also have strong capabilities in complementary metal-oxide semiconductor technology, favored for its low power, radiation-resistant characteristics. Japan also has an emerging semiconductor production equipment technology that will rival U.S. capabilities. The emphasis is on increasing the degree of automation of production facilities, as well as on improving the ability to produce high density devices. While the United States retains a firm lead in microprocessor technology, the Japanese could pass us in worldwide market share by 1986 or 1987, according to industry estimates.

Semiconductor Production Equipment. Competition from Japanese producers of semiconductor production equipment--wafer processing equipment, test equipment, and assembly equipment--has grown significantly in the last four years. From 1979 to 1983 Japan's share of the worldwide market more than doubled, from 14 to 32 percent, while the U.S. share dropped to 65 percent from 79 percent. The dramatic increases projected for semiconductor devices for 1984 and 1985 will provide Japanese semiconductor production equipment manufacturers opportunities for further market expansion.

Fiber Optics Systems. Fiber optics communications systems are the fastest growing transmission medium in the worldwide effort to convert to the integrated services digital network (ISDN). Conservative estimates predict the world market will reach almost $4 billion by 1988. The United States is the largest user of fiber optic systems with approximately 40 percent of the world total. The Japanese government has targeted fiber optics for rapid development and is encouraging Japanese cooperative R&D. About 20 leading computer, telephone equipment, electric wire and cable, and electronic manufacturing companies have set up an Optoelectronics Industry Promotion Association (OIPA) for accelerating research and development of optoelectronic products and technologies.

MITI has backed this joint industry effort with the equivalent of an $80 million investment. To achieve economies of scale and to move up on the learning curve, the Japanese have installed production capacity that is four or five times greater than domestic demand.

Biotechnology. Although the United States has the lead in recombinant DNA and cell culture technologies, there are gaps in U.S. process technology and the skilled manpower available to meet future needs. Other nations are making substantial investments in the commercialization process in which the United States has no clear lead. Japan has an undisputed lead in fermentation processes, a critical segment for commercialization, and is aggressively seeking to build on this strength. In a recent report, our Congressional Office of Technology Assessment concluded that the science base which supports innovations in biotechnology may be eroded if Federal funding for basic life science research continues to decline. After the United States, Japan has the most financing available for companies in the biotechnology field, and the Japanese have targeted biotechnology as a national priority.

Pharmaceuticals. American dominance of world pharmaceutical markets has been steadily reduced over the past twenty years. In the antibiotics sector, Japanese manufacturers are the world leaders in new compounds, and seven of eleven new antibiotics developed in 1979 originated in Japanese laboratories.

Expenditures by U.S.-owned companies for research at home and abroad have not matched the expansion of total foreign-owned firms' research efforts. The U.S. share of world pharmaceutical research has fallen from about two-thirds in the early 1960s to just above one-third today with Japan, West Germany, and the United Kingdom experiencing higher growth rates.

Robotics. Although the United States continues to lead in robotics research and design, Japan has surpassed it in robot production and use. According to a narrow U.S. definition of robots, which excludes simple mechanical devices, Japan currently has about three and a half times as many robots in use as the United States. Starting with technology licensed by U.S. firms, Japanese manufacturers have developed robots for a broad spectrum of applications. Over 70 percent of all robots used in Japan perform machine tool loading and assembly operations, compared with 21 percent in the United States. Japan's experience in this industry--which is expected to be a major growth market--may give it a significant advantage in penetrating the U.S. robotics market. Several U.S. firms have entered into licensing arrangements with foreign companies in an attempt to accelerate their own entry into this field.

Mr. Chairman, this is by no means an exahustive review of all the industries affected, but it does provide a barometer of the work we have cut out for us.

Foreign technical information is costly to gather and even more costly to screen and interpret in the context of specific needs. Systematic and timely access to relevant information on foreign technical developments is effectively beyond the reach of most U.S. firms.

Various schemes have been developed in other countries to improve the access of individual firms to foreign technical intelligence. In Japan, for example, groups of industrial firms have formed information- sharing clubs. Members share data they have acquired (often incidental to their main activities) on foreign technical developments. Such information may include market intelligence, debriefing reports from foreign visits and technical documents.

U.S. trade, professional and regional business associations would seem to be potential natural foci for information sharing activities. However, the agenda of these groups usually does not include foreign technical information collection and dissemination. An example of Government cooperation might involve making available to such information sharing groups foreign technical information collected by U.S. Government agencies. Of course, the difficult part is converting raw information into usable, practical form.

One positive step the Government can take is to accelerate the rate at which Federally-funded technology is diffused to the U.S. private sector for conversion into advanced products or processes. The Japanese have been past masters at exploiting the traditional dissemination lag in this arena by acquiring U.S.-developed innovations when they are at a vulnerable, undercapitalized stage, and then providing for their further development. To counter this, we should take greater pains to get the fruits of our own R&D into U.S. industry hands, before the Japanese or others have time to preempt our own firms.

We have taken some steps to accomplish this. For example, the transfer of Federally-funded technology to the private sector is being pursued through Federal patent policy changes that "automatically" transfer new technology to the organizations that develop it and that have the incentive to commercialize it, rather than continuing the process of "warehousing" and licensing it at a later time. We have also identified a systems approach designed to increase the flow of commercializable technology from Federal laboratories. This is highlighted in the Department's recent report to the Congress on the Stevenson-Wydler Technology Innovation Act of 1980 (PL 96-480).

As I noted at the outset, Mr. Chairman, it is important to explore better systems for acquiring Japanese and other industrialized nations' technological information. However, in this effort, I hope that the Congress will not be distracted from taking some measures that can enhance the innovation process here at home. Some examples of this include:

- investigating the advantages of extending the 25 percent R&D incremental tax credit to those that can use it best, including start-up ventures;

- passing the Administration's proposed antitrust legislation ("The National Productivity and Innovation Act of 1983"), removing barriers to cooperative R&D ventures and the procompetitive exercise of intellectual property rights;

- passing legislation which increases intellectual property protection for microchips (H.R. 1028); and

- passing legislation to extend contractor ownership of Federally-funded inventions, as specified under P.L. 96-517, to Federally funded research and development performers not now covered by that Act.

In this connection it is interesting to note that the President's Commission on Industrial Competitiveness (PCIC) endorsed eight recommendations in February to encourage innovation and industrial competitiveness in R&D and in international trade. All of the foregoing were included among them.

For our own part, the Department of Commerce and the Administration have made substantial progress in carrying out the intent of the Stevenson-Wydler Act to increase cooperative R&D, technology transfer and industrial innovaton. Our strategy focuses on enhancing the effectiveness of the multi-step process of innovation. We have identified weak points in the innovation process and suggested initiatives for remedial action. These initiatives can be categorized in terms of removing barriers to innovation, strengthening incentives for private sector action, and providing catalytic services and information in non-interventionist ways.

In conclusion, Mr. Chairman, I believe that we should explore any legitimate vehicle to become more knowledgeable about foreign technological advances.

Mr. WALGREN. Thank you very much, Dr. Merrifield.

We will come back to that panel as a whole, but following our format, turn now to Mr. Shonyo.

Mr. SHONYO. I want to thank you, Mr. Chairman, for inviting me to summarize for you our activities at NTIS in the area of collecting Japanese scientific technical information.

NTIS has always had a certain collection of foreign technical literature primarily as a result of other Government agencies collecting material and depositing with us.

But in 1981, NTIS began actively seeking out and collecting foreign technical information which is of potential use and value to U.S. industry.

This effort resulted directly from a domestic policy review which was undertaken under White House auspices in 1978 and 1979. The policy review panel recognized the fact that other industrialized nations were collecting technology then, as now, on the United States, whereas, we did not have any capability to reciprocate.

As a partial measure or solution to that problem the policy review panel recommended that NTIS be given the authority to actively seek out, translate, and disseminate technical information of potential use to U.S. industry.

Congress did in fact authorize an appropriation for NTIS during fiscal year 1981. The appropriation amounted to $750,000 the first year, it declined to $500,000 the second year, and $250,000 the third year. But it was always intended that this program eventually become self-supporting. And as the appropriation declined, NTIS progressively supported the program with its own funds and in fiscal year 1984, the program became fully self-supporting at NTIS.

As originally implemented, the program had four primary objectives. The first was to identify the perceived foreign technical information needs of U.S. industry; second, to actively seek out technical information in response to these perceived needs.

The third aspect of the program was to translate into English the most important technical information acquired through the program and; finally, to disseminate in an effective way this information to U.S. industry.

There were several constraints on the kind of information that NTIS could acquire. First of all, we felt there had to be some good reason that the U.S. Government should be involved in acquiring information in the first place. This means that we were not, or are not, interested in the open journal literature, published monographs, anything that can be obtained commercially.

Primarily what we are interested in is the technical report literature generated by government agencies by industries in which some form of negotiation on the part of the U.S. Government is necessary to acquire that information.

A second constraint is that NTIS must have a clear right to reproduce and sell the information, which means, in most cases, we must obtain a copyright release. And the United States is one of the few countries in which government produced information is in the public domain. In Japan and other countries it is generally copyrighted.

A final constraint that was placed on the kind of information that we could acquire through this program is that it must be of potential interest to U.S. industry.

At the beginning of the program we undertook three studies in an effort to determine U.S. industry's interest in foreign technical information. We did a study in conjunction with the conference board which surveyed about 500 VP's for research in a variety of U.S. companies. We did a survey of trade and industry associations and we held discussions with existing United States—I should say existing NTIS—users, in a variety of U.S. companies.

The acquisition component of the program has been approached in several ways. One of the major ways is by direct contact with senior NTIS staff, with potential source organizations of technical information. And this usually results in a negotiated memorandum of understanding or some sort of formal agreement which allows NTIS to reproduce and sell the documents obtained from these organizations.

The second major acquisition approach stems from the fact that NTIS has cooperating organizations in various countries, including Japan, and these organizations do several things for NTIS. One of the things is to act as a distributor of NTIS products in the country. And in exchange for the privilege of doing this, we require in our agreements for these companies that they assist us in our acquisition effort.

Finally, in key countries, including Japan, NTIS has a full-time acquisitions representative. In Japan it happens to be a retired executive from the National Development Bank of Japan, that has very good contacts in the private sector and has freed up quite a bit of technical information that exists in the private sector in Japan for distribution through NTIS.

NTIS acquires approximately 800 Japanese technical reports a year. This is about 5 percent of our total input of foreign documents. Now, the primary constraint here is the Japanese language. NTIS must have at least an English title and an English abstract to enter the material into the NTIS collection. Figures of 20 to 25 percent have been given for the extent of English-produced, or English language literature in Japan. But when you talk about technical report literature, this percentage drops very drastically because most technical reports were only intended to be read by a few people and those people are almost always Japanese reading people.

To date, NTIS has formal agreements, acquisitions agreements, with 16 organizations in Japan. These are listed in the appendix to my written statement. We have agreements pending with a good number of other organizations, the most important of these is the Agency for Industrial Science and Technology, which is the research arm of MITI.

We will enter an agreement with the Agency for Industrial Science and Technology which, I understand, will be signed on March 15. And we should begin receiving technical reports from that organization by the April 1.

Now, for the first time, we will be getting documents from Japan which are roughly equivalent to the kinds of documents that Japan gets from NTIS. So, in the spirit, if not in actual numbers, a form of reciprocity will indeed have been achieved with the signing of this agreement.

Our experience with the translation of Japanese language material has been that it is both considerably more expensive and more difficult to find a translator for the material than it is with European languages. And I think this has been stressed over and over again today.

We try to let contracts to a variety of U.S. firms to do the translations for us but when we sent our materials, they were invariably sent back to us and they said they couldn't translate them due to the highly technical nature of the materials that we were receiving.

We received quotas in our contract running from about $20 to $260 per thousand words translated. And we just went up the list of the people that responded to our request for procurement and every one of them sent the documents back to us.

As an experiment, we began sending some documents to Japan to have translated through our cooperating agency there, which is the Mitsubishi Research Institute, and most of the documents that we finally ended up having translated were done through that means.

As I mentioned earlier, beginning in fiscal year 1984, the program became self-supporting at NTIS. The budget is around $250,000. This does not leave much slack for translation. What we are concentrating in doing is keeping our lines of supply open and establishing new sources of technical information.

I might emphasize that $250,000 is our worldwide foreign technology program, not just the amount that is being spent on Japan.

Mr. **Walgren**. Let me ask you if I might——

Mr. **Shonyo**. Yes.

Mr. **Walgren** [continuing]. The overhead of maintaining that one individual in Japan. Does that come out of that $250,000?

Mr. **Shonyo**. That's correct.

Mr. **Walgren**. And what would his salary be?

Mr. **Shonyo**. He is paid in the vicinity of $50,000, per year.

Mr. **Walgren**. So the net effort for the rest of the program, sans him, as they say, is $200,000?

Mr. **Shonyo**. That's correct.

Mr. **Walgren**. Thank you.

Mr. **Shonyo**. Yes.

That more or less concludes the highlights of my testimony here today. I would be glad to answer any questions that the committee has.

[The prepared statement of Mr. Shonyo follows:]

THE COLLECTION AND DISSEMINATION OF JAPANESE TECHNICAL REPORT LITERATURE AT THE NATIONAL TECHNICAL INFORMATION SERVICE

Prepared for hearings on
Japanese Science and Engineering Literature
U.S. House of Representatives
Subcommittee of Science, Research and Technology
March 6-7, 1984

David B. Shonyo
Acting Director, Office of International Affairs
National Technical Information Service

The National Technical Information Service (NTIS) of the U.S. Department of Commerce has been engaged actively in the acquisition and dissemination of certain kinds of Japanese technical information since 1981. The narrative which follows summarizes the background of this activity and NTIS' experiences with it.

The primary function of NTIS is to make available to the public the technical information which results from research done for or by the U.S. Government. This is done by collecting, processing and disseminating technical reports and other information products generated by the research. NTIS' enabling legislation (15 U.S. Code 1151-7) also requires that NTIS perform this function with respect to technical information originating outside the Government, when this is practical and desirable. In fact, the roots of NTIS are in the post World War II collection and dissemination of technical information generated during the German and Japanese wartime R&D efforts. NTIS operates on a self-supporting basis; users of NTIS, not the tax-paying public, pay for its operation. Occasionally, Congress asks NTIS to undertake some special task and provides an appropriation to do so, but NTIS' overall operation is not subsidized with tax monies.

NEED FOR A FOREIGN TECHNICAL REPORT PROGRAM

In 1978-79, a Domestic Policy Review on Industrial Innovation was conducted under White House auspices. The Policy Review panel recognized the fact that other industrialized nations were actively collecting industrial/technical information from the

U.S., while the U.S. had no active mechanism for collecting similar information from other countries and making it available to U.S. industry. The panel recommended that NTIS be given the responsibility of actively collecting, translating, and disseminating technical information of potential interest to U.S. industry.

Congress did, in fact, authorize funds in fiscal year 1981 for NTIS to undertake such a program; but it was always the intention of NTIS that the program would eventually become self-supporting. Thus, while $750,000 was appropriated in fiscal year 1981, the amount was reduced to $500,000 in fiscal 1982 and $250,000 in fiscal year 1983. In fiscal year 1984, NTIS did not request an appropriation and since has been supporting the program with sales revenues.

The program as originally implemented, had four main components:

(1) Identification of the perceived foreign technical information needs of U.S. industry;

(2) Actively seeking out and acquiring foreign technical documents of possible interest to U.S. industry;

(3) Translation into English of the most important foreign-language materials so acquired;

(4) Dissemination of the information acquired to U.S. industry.

ACQUISITION OF FOREIGN TECHNICAL REPORTS

There have been several constraints placed on the kinds of materials acquired through this program. First, there must be some good reason why the U.S. Government should be involved in its acquisition. Items which are or can be readily made available commercially are not of interest to the program. Second, NTIS must have a clear right to reproduce and sell the material. Finally, the information acquired must be of potential interest and use to U.S. industry.

In an effort to respond to the foreign technical information needs of U.S. industry, three major studies were undertaken during the first year of the program. These were: (1) a survey of the VP's for research (or equivalents) of over 500 major industrial; (2) discussions with trade and industry association officers; and (3) interviews with a wide variety of NTIS users from business and industry. Also, a study was made of U.S. patent filings made foreign firms in an effort to identify major foreign industrial R&D thrusts. Acquisition emphasis was structured to meet the needs revealed by these studies. NTIS remains responsive to suggestions made on an individual basis.

The acquisition component of the program has been approached in several ways. One of these has been by direct contact by senior NTIS staff with officials of foreign government agencies and other organizations. Whenever warranted, bilateral agreements are negotiated.

The second major acquisitions approach stems from the fact that NTIS has, for some years, worked with cooperating organizations in many countries. These organizations handle NTIS sales and related affairs within their own countries. They also are required, under the terms of their agreement with NTIS, to acquire technical information on behalf of NTIS.

Lastly, in key countries (including Japan), NTIS has established full-time acquisition representatives. These are resident individuals with a thorough knowledge of the information and documentation infrastructure of their respective countries.

The task of the representatives is to identify potential sources of relevant technical reports, approach the sources in person to assess the desirability of the reports and to determine interest in cooperating with NTIS. If interest is positive, either the representative or an NTIS staff member will negotiate terms.

NTIS EXPERIENCE WITH JAPANESE TECHNICAL LITERATURE

There are a half dozen discrete steps involved in accessing Japanese data. These include:

(1) Negotiation with individual associations and companies to release publications since much of the data developed are not in the public domain.

(2) Screening the data that is made available to identify reports that are worthy of acquiring and possibly translating.

(3) Translation of selected reports.

(4) Abstracting and indexing the documents for entry into the NTIS data base.

(5) Entry into the data base.

(6) Dissemination to interested companies or individuals.

NTIS currently is accomplishing all of these steps in limited degree, but the bottlenecks are in negotiation and translation.

Negotiations with Japanese sources of technical report literature have tended to be rather protracted. This is because there is little precedent in Japan for making this kind of literature available to the public. Technical reports produced by the Japanese Government are not, for example, even available to the Japan Information Center for Science and Technology (JICST), which is the closest Japanese counterpart to NTIS.

The most usual instrument for controlling, and even delaying, the release of unclassified Japanese technical reports is Japanese copyright law. All Japanese Government technical reports are copyrighted. Techhically, to obtain a release to reproduce a technical report, permission should be obtained from each individual author, the sponsoring organization, and the issuing organization. It has been found, however, that if a Japanese organization truly wishes to cooperate, a blanket copyright release can be given.

To date, NTIS has made acquisition arrangements with 16 Japanese organizations, and has others in various stages of negotiation. (See the attached Appendix) Many of these organizations are private firms. This is in part because the NTIS acquisition representative in Japan, a former senior executive of the Japan Development Bank, has strong connections in the private sector. These firms are motivated to provide their technical reports to NTIS primarily because they feel that it is good public relations to do so. The most important of the pending agreements is that with the Agency for Industrial Science and

Technology (AIST), which is the research arm of the Ministry of International Trade and Industry (MITI). Negotiations with AIST which began about three years ago are now in the final stages. This agreement will give NTIS access to the technical report literature generated by the various AIST laboratories. This material is roughly equivalent to the kind of U.S. material Japan is receiving via NTIS, so further reciprocity will have been achieved.

Japanese technical documents represent about 5% of the total foreign documents processed into the NTIS data base. Although NTIS has potential access to a great many additional Japanese technical publications, the number actually that can be accepted into the NTIS data base is limited severely by the language barrier. In contrast to the scientific journal literature, very little Japanese technical report literature has even an English-language abstract or title. When an English abstract and title are available, a Japanese language report sometimes will be entered into the NTIS data base. This is done with reluctance, however, because almost none of such reports have ever been sold.

In comparison with European-language technical materials, it has been both more expensive to have Japanese language materials translated, and considerably more difficult to find qualified technical translators. NTIS normally has its translation work done by the U.S. Joint Publications Research Service (JPRS). JPRS, however, has not been able to accept any Japanese-language work from NTIS. Attempts to establish a translation service through a procurement contract have likewise been unsuccessful.

No vendor responding to our Request for Procurement would agree to accept the variety of highly technical documents that NTIS needs to have translated. A few documents finally were translated in Japan on an experimental basis, through an arrangement with the NTIS Japanese cooperating representative (Mitsubishi Research Institute). The translations were done by Japanese technical experts with a knowledge of English, rather than professional translators, and required extensive editing to be useable.

Approximately a dozen Japanese documents have reached sales of greater than 50 copies per document. The over-all average is sale of 12 copies of each Japanese document acquired. This compares with an average of about five copies per title of all foreign documents in the NTIS collection.

The program began to operate on a self-sustaining basis beginning with fiscal year 1984. It is supported with revenues generated through sales of the foreign documents acquired through the program. The budget is currently about $250,000. Emphasis is being given to establishing new sources of information, and keeping existing lines of supply open. To this end, an in-country acquisition representative is being maintained in Japan (as well as one in Europe). It probably will not be possible to translate more than 10 Japanese documents into English during the year. This will limit the usefulness of MITI/AIST technical reports.

It is anticipated that NTIS will continue to support, with its normal traditional revenues, a program for the acquisition of Japanese technical report literature. Translation probably will remain a problem. Other Government agencies will sometimes translate materials for NTIS, and more assistance of this kind is being sought.

CONCLUSION

We should note two important trends since the inception of the current foreign technology acquisition program at NTIS. First, U.S. users of technical information have become considerably more aware of the potential value of foreign technical information. Demand (i.e., sales) for foreign technical reports has grown over five-fold during the past 3½ years. Secondly, the Japanese have come to realize that they share with us the problem of reciprocity in the flow of technical information between Japan and the United States.

Finally, it should be emphasized that the NTIS program differs in at least one important respect from other acquisition efforts: it is concerned with the technical report literature. This literature normally is intended for a limited readership. Even technical reports which are not classified for security or proprietary reasons generally are not made available to the public in Japan.

The journey from the laboratory to the printed pages of technical journals and monographs is, if anything, a more lengthy one in Japan than in the United States. Technical reports tend to be issued considerably more quickly and contain more detail than their journal-article and monographic equivalents. In terms of immediacy, technical reports fall somewhere between face-to-face communication and the formal publication process.

The vast technical journal and monographic literature of Japan always has been available to anyone who wished to take the trouble of acquiring it. Now, for the first time, the Japanese technical report literature gradually is becoming available to the U.S. public. However, the problem of language remains a major barrier to the utilization of both of these knowledge resources.

I will be pleased to answer any questions that the committee may have.

APPENDIX

Japanese organizations which have an agreement with NTIS for the provision of technical reports:

Asahi Glass Company
Dainichi-Nippon Cables, Ltd.
Faculty of Engineering, University of Tokyo
Kenyusha Foundation
Ministry of Labor
Nippon Kokan Co., Ltd.
Nippon Steel Corporation
Okochi Memorial Foundation
Osaka Municipal Government
Science and Technology Agency
Taisei Corporation
Toshiba Corporation
Japan Information Center for Science and Technology
National Aerospace Laboratory
Kajima Institute of Construction Technology
Mitsubishi Heavy Industries, Ltd.

Organizations with which agreements are currently under negotiation:

- Agency of Industrial Science and Technology
- Disaster Prevention Research Laboratory, University of Kyoto
- Matsushita Electric Industries
- Sumitomo Electric Industries
- Fujii Electric Company
- Kanebo Cotton Yarn Company, Ltd.
- National Institute of Resources
- National Institute for Research in Inorganic Materials
- Japan Marine Science and Technology Center
- Electronic Navigation Research Institute, Ministry of Transport
- Kawasaki Steel Company
- Sumitomo Steel Company
- Kobe Steel Company
- Port and Harbor Research Institute, Ministry of Transport
- Ship Research Institute, Ministry of Transport
- National Institute of Radiological Sciences
- National Space Development Agency of Japan

David B. Shonyo
Acting Director
Office of International Affairs
National Technical Information Service (NTIS)

Mr. Shonyo received a B.A. from the University of Minnesota in 1962, and subsequently did graduate-level work in chemistry at George Washington and American Universities. He joined the Office of Technical Services of the U.S. Department of Commerce in 1962 as a technical information analyst. In 1970, Shonyo initiated the first in a still-continuing series of U.S. AID-funded programs at NTIS, and travelled extensively in developing countries in connection with these programs. Shonyo assumed responsibility for the Foreign Technology Acquisition Program at its inception in 1980, and was named Chief, Foreign Technology Exchange Division in 1981. In addition to maintaining the foregoing responsibility, he has been Acting Director of the NTIS Office of International Affairs since September 1982.

Mr. WALGREN. Is it the $250,000 that's self-supporting? I mean, that's what we're earning from the sale of the——

Mr. SHONYO. That's——

Mr. WALGREN [continuing]. Material and——

Mr. SHONYO. That's correct. That $250,000 is derived from the sale of foreign technical information and put back into the program.

Mr. WALGREN. Um-hum. Was NTIS in the business of distributing foreign technical information prior to 1981 when this particular initiative——

Mr. SHONYO. Yes.

Mr. WALGREN [continuing]. Was——

Mr. SHONYO. Yes, it was on a rather passive basis. We had no active collection program at that time. I think that's the main difference between then and now. We accepted documents that other government agencies had collected as a result of exchange agreements usually with their Japanese counterparts, or their foreign counterparts, and just deposited with NTIS.

Mr. WALGREN. What kind of comparison is there in the volume of use, or volume of activity in the foreign document area, pre-1981 and post-1981?

Mr. SHONYO. Of course, we judge our volume of use through the sales of documents, and taking just numbers sold, the number sold has increased about fivefold in the past 3 years that the program has really been active.

Mr. WALGREN. Um-hum.

Mr. SHONYO. And this increase is not attributable to the fact that we just have more documents. The number of documents we have in the collection hasn't grown fivefold by any means.

Mr. WALGREN. Um-hum. I see. Well, OK.

Mr. Mu, did you have a statement, and would you like to comment? And I want to give Dr. Caponio an opportunity also.

Mr. MU. Actually I have submitted a statement for the record——the record——

Mr. WALGREN. Fine.

Mr. MU [continuing]. In written form and the essence of the statement is to talk about the program that we have embarked on in fiscal year 1984 in the International Trade Administration of the Department of Commerce, that is working around the subject of Japanese science and technology literature that is driving the assessments of Japanese technology in four different areas.

We have a contract that will create four panels in computer science, mechatronics, nonsilicon based materials, and in biotechnology. And one of the special features of the program in looking at the competitive assessments and its implications on—on our commercial competitiveness, is that the panel members were made up of generally—we are identifying people from academics, academia, business, as well as Government, who are familiar with much of the open source English language literature in Japan.

A special feature of the program—you know, once these panels are formed, is to work with the contractor to go about a series of interactions to look at literature that is not traditionally used, research reports that are not traditionally translated, to drive each of the panels not only to look at the competitive assessment aspect of it, but to look at and to see if we can survey the quality of Japanese S & T literature; how best to access it; what are the best—best ones to access. And perhaps at the end of the pilot project itself to come up with some recommendations as to how best to build this program on a continuing basis in the private sector.

And that, in essence, is the program that we have embarked on. I—we have only had one panel that is set up, one that is—had one meeting. But just as I said, the panelists themselves, from industries, and from academia, are what I would say is very intimately aware of the kinds of work that the Japanese are doing, and they keep up with the literature themselves.

In fact, we came back from a meeting with the Computer Science Board just last week, and in their interaction with the contractors, you know, who had surveyed a number of literature that he didn't believe was available. For instance, in Japan's supercomputer projects, this is done through a number of research associations.

In the summer of last year, the—and these research associations are really subdivided into research that are done by the individual Japanese companies that, you know, feed into a component. So that to wait for a final report, a midterm report on this particular research projects, one might wait 2 years, 4 years, or 8 years, for a report to come out, and then to have it translated.

At the same time, the people who are part of this project meet on an annual basis where they exchange what is known as informal papers, on where they are. For instance, the Super-Speed Computer Research Association, had its first workshop on computational scheme on algorithm workshop. And primarily looking at parallel processing algorithm.

And we had a number of people in our panels, you know, who were quite surprised at the kinds of works that already existed, you know, that it was not more than one-half a year old, information that was not available.

Another example with this particular panel would be the new functional device, the research association, also connected with the fifth generation computer, and the supercomputer project in Japan, also had a workshop in which papers were, you know, were disseminated in the areas of superlattice, lattice, elements environmental resistant, elements, three dimensional IC elements.

And the—I was present at that panel and I was quite surprised to see the surprise on the part of the so-called experts. As I said, the project has just started off. We have the computer science panel somewhere halfway finished. We have just started the mechatronics panels and we intend to kick off before summer of this year, the biotechnology as well as the nonsolicitation materials.

But I think the important thing other than the technical assessments that we are looking for is that we are beginning to see some trends on the surveys of what we call open source but difficult-to-get-your-hands-on technical literatures that are being generated not only in the research association sponsored by the Government but also the kinds of interaction that takes place between universities, between private firms, and public universities.

And all of this would just bring up raw data that we just planned to analyze and perhaps have some findings to present before the committee at some point next year.

[The prepared statement of Mr. Mu follows:]

STATEMENT FOR THE RECORD
GEORGE MU
DEPUTY DIRECTOR
OFFICE OF JAPAN
DEPARTMENT OF COMMERCE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
MARCH ~~7~~, 1984
6,

It is a pleasure to present this statement for the Record to the Subcommittee on Science, Research and Technology. I wish to comment on the need to accelerate the acquisition and translation of Japanese scientific and technical literature and to increase the utilization of this information by U.S. industry to strengthen its competitive posture.

The ability of Japanese firms to access the large base of open-source R&D literature and activities in the U.S. has given them a competitive edge to respond to U.S. developments and trends on a timely basis. The reverse of this situation for the U.S. is not true. A significant gap exists between available translated Japanese technical literature and the wealth of untranslated technical texts that exist in Japan. It is necessary to narrow this gap to enable us to assess better the competitive position of select Japanese industry sectors. To accomplish this the Office of Japan, International Trade Administration of the Department of Commerce and the National Science Foundation are sponsoring a pilot program in FY'84 to study Japanese advancements in four critical industrial sectors, i.e. computer science, mechantronics, nonsilicon based microelectronics and biotechnology.

Technical and competitive assessments for these four sectors are to be developed by four separate panels, comprised of leading authorities from industry, the scientific community and government. They will rely upon scientific and technical information from a translation service established by the contractor. One of the important features of this pilot program is that the contractor will access, select and translate Japanese scientific and technical information for dissemination to the appropriate panels for assessment.

The final product of each of the panels will be a report outlining the current status and the future short and long-term trends of Japanese research and development efforts which are aimed at fostering enhanced capabilities in each of the four sectors. Further, the reports will focus on Japanese resources in industry, laboratories and government that may be qualitatively superior in any way. They will examine industry and government programs and initiatives which led to the present Japanese position, and include a projection for the possible effects on the U.S. and other nations. Finally, the reports will provide an analysis and evaluation of the scientific and technical literature used in each of the sectors and will comment on the utility of using the newly identified sources in making future assessments.

In addition to the four final reports, a special report on Japanese scientific and technical literature will also be submitted by the contractor. Its purpose will be twofold. First, it will document the technical information/translation service and describe the panels' operation. Included in this portion will be citations of the number of Japanese institutions contacted, the number of documents translated, the number of documents reviewed, the number of hours engaged in translation activity, and a description of the screening process for data bases and publications. Second, it will explain the selection process of panelists, the methodology of distributing information to the panelists, and the procedures used to evaluate findings. It is hoped that this information will form the basis for our survey of science and technology literature in Japan and suggest ways in which U.S. companies might best access these sources.

As of this date, the computer science panel has been established. It has identified subtopics such as software, artifical intelligence, man-machine, supercomputer memory technology, non-von Neumann architecture, and communications networks for assessment. Assignments were made by the chairmen at a November 1983 meeting to assess the initial literature available, to identify additional data/translation needs, and to modify and/or expand the general outline report. In its next meeting in March 1984, additional information requirements from Japanese sources will be made and final assignments will be confirmed for each panelist. It is expected that a draft final report will be completed by the panel in June, 1984. A similar process has begun for the mechantronics panel which held its kick-off meeting in February 7, 1983 and we expect to have the final two panels in process by the end of April.

While it is still too early to prejudge the results of this pilot program, the Department of Commerce is confident the final products of this project will be highly professional technical assessments of the commercial and competitive position of the Japanese industry in the selected sectors and the implications for affected U.S. industries. We will be able to gain insights based on our experience of accessing, translating and surveying Japanese science and technology literature which have not been traditionally available. We will be better able to comment on the quality of R&D in Japan, to assess how much of the significant developments in Japan are translated into English, and to suggest ways and means to increase the utilization of this information to meet American competitive requirements.

The funding for this pilot project is for a period of one year. We expect the results of the panels and the experience gained in accessing and analyzing untranslated Japanese texts to serve as a model for U.S. firms and government agencies to pursue their own interests along similar methods. Just the same, we would like to have an opportunity to appear before this Committee again next year to review the final results and to comment in detail on what we have learned in our survey of Japanese science and technical literature in connection with this project.

Thank you.

Id #317

Mr. **Walgren**. Now, is this part of NTIS?

Mr. **Mu**. No it isn't. This particular project is a venture between the Department of Commerce and the National Science Foundation. And looking at the problem of S&T literature, we all recognize that there is a, you know, a dearth of translation, but none of us know what the quality of that translation would be.

And, you know, and, in fact, if it were translated, whether it was going to be worth anything or not; our assumption is that it is. You know, they are on top of that. Since so much of it is untranslated, what ought to be translated was a problem that we were trying to zero in as well.

Mr. **Walgren**. Um-hum. And that's totally focused on Japan, that——

Mr. **Mu**. That's correct.

Mr. **Walgren**. I see.

Dr. Caponio, do you want to add anything?

Mr. **Caponio**. Mr. Chairman, I don't have a formal statement for the record but I would just like to make three comments with respect to the overall problem concerning the exploitation of the Japanese scientific and technical literature.

And the first one I think has already been alluded to by Justin Bloom, and that is the—there has to be a demonstration of the demand for the utilization of this technical information by the American scientist and engineer.

Second, the most important facet with respect to the entire problem is the language barrier, and I believe that the only way that this problem is going to be overcome or resolved is by introducing into the university curriculum a restoration of the requirement for foreign languages.

As you know, Mr. Chairman, a student can graduate from high school, obtain a bachelor's degree, a master's degree, and even a doctorate in philosophy today, without having one additional foreign language.

I think that this is an indictment of the American higher level of education.

The third problem: I do know, as you recall, Mr. Chairman, that in 1958 after the launching of the Sputnik, there was the same concern with respect to keeping abreast of the Soviet, the USSR literature; and this is exactly where we are today. And I do think that—that there may come a time when we will be able to utilize machine or computer-aided translation.

I dare say that this is not within the—the immediate realm of pragmatic application for at least 5 years and, therefore, I do not see that that is going to ameliorate the basic problem.

Those are the three comments I would like to make. I would be happy to respond to all or any questions but I do think that Dr. Merrifield and Dave Shonyo have given you the NTIS position.

Mr. **Walgren**. Thank you, Mr.—very, very much, Dr. Caponio.

I just can't resist the analogy of the most talked about commercial these days which has that line in it, "Where's the beef, Bruce?" [Laughter.]

And I would not accuse you of having offered up a fluffy bun of any kind but, and I admire you for not doing so. [Laughter.]

But, nonetheless, the question really is: Is there anybody back there? And if all you've got is that one guy in Japan eating up one-sixth of the total budget of NTIS, clearly we—we're not meeting the need.

Dr. **Merrifield**. Yes, indeed, that's right. And, of course, I think, again, that's where we have to multiply this capability, share the risk. And I see that happening in the private sector but I see it happening through these consortia where you have a whole bunch of companies like the Semiconductor Industry Association collaborating together to fund the translations that they need; working in concert with the NTIS to do this or the data base dissemination; but funding of the work through the association itself.

I think that what I'm trying to do, of course, is set up these limited partnerships, a number of them, and almost all the industry associations.

Until that happens, I think that—that the critical massive capability is not going to be there.

Mr. **Walgren**. But aren't we—Well, let me ask you this: What's the experience thus far ~~in these~~ consortiums having actually engaged in the translation of substantial amounts of material?

Dr. **Merrifield**. Well, I think, again, we have to recognize there's been a bit of arrogance in our American industries here. We've been the leader forever and it's pretty hard to swallow the fact that we may not be, and in fact we're not in many areas—and it's a sensitization process and an education process. And I think that some of these people now are getting more than a little bit anxious and frightened by the fact that they no longer are competitive and realize that this is an urgent thing.

But it's a new—but it's a recent development. And so—and it's just beginning to build, and I think we will see a rather significant increase in concern and interest and I think we will see the interest in accessing information, whatever information we can put to the NTIS and any other data base, growing very rapidly now.

But it's just a—remember just within the last few years, this has really only become a significant problem, perceived of them to become a significant problem.

And it—in fact, until its been articulated by some of us, and I do this for my friends in industry all the time, it—acknowledge it at first but then at—but they haven't moved to do anything about it yet. And so it's just a beginning program.

Mr. **Walgren**. I grew up in Pittsburgh in the fifties when the Pirates were playing baseball, and it was always wait until next year. [Laughter.]

And that covered a host of sins on the part of that organization. I can't help but note how much you believe in those limited partnerships and the private sector; and I realize how much the private sector has to contribute. At the same time, we've been urging them for a couple of years now, and there is still not much delivery.

Why isn't the ITA doing this through the NTIS? It seems that you're in very much the same area. What's the reason for running this Japanese project through an independent, or through a separate Commerce Department arm rather than the National Technical Information Service, which I gather is trying to do the same thing?

Dr. Merrifield. It's a little different.

George, maybe you can explain the origin of that contract.

Mr. Mu. Well, much of what is available in NTIS is, as I explained in the creation of panels, before we even have meetings with the experts, the contractor, together with inputs from embassy sources in Tokyo and a number of other outside sources, identifies what we think is the traditional open source literature.

One of the first places that we actually look is at the NTIS survey. And we go from that as the open source, to the next step to see what else is available in the open source that is not traditionally used?

I think I'm not answering your question. Let me come back to that.

I do not know the reason why this program [laughter].

Mr. Walgren. Well, then, maybe we had better ask the boss. [Laughter].

Mr. Mu. I am aware that there was some year-end moneys available at ITA and at the National Science Foundation. And that the two of them got together and handed me a project when I returned from Japan this year.

Mr. Walgren. Is it such an effort to keep the NTIS fully funding itself, that this effort would not fit in there?

Dr. Merrifield. Oh, I don't think that would be a problem, would it, Joe?

Dr. Caponio. If I may, Mr. Chairman, I think one of the reasons is that in this particular program the basic objective is to assess the state of the art the state of the technology regarding certain categorical areas; one of which is in the field of microelectronics; whereas, the basic NTIS mission is to identify, acquire, process, and disseminate the technical information. The distinction here is that the NTIS mandate is to acquire and distribute information. In the particular program that has been alluded to by Mr. Mu, it is actually to assess the state of the technology within that categorical area.

Mr. Walgren. Well, but isn't it true, though, that the NTIS is doing such a selective job in acquiring that they had better be making some assessments?

Dr. Caponio. Mr. Chairman, the expertise that exists within the NTIS is not sufficient or adequate to make the evaluations and the assessments of the——

Mr. Walgren. With that capacity they'll be in the NTIS, though. Shouldn't they have that expertise?

Dr. Caponio. It is possible. It has never been in the past; it is possible, Mr. Chairman, that should be, yes.

Mr. Walgren. I wanted to ask Mr. Shonyo, about the requirement that NITS be able to sell the document; are there things that we're not accessing at NTIS that we ought to be, based on the requirement that you sell the document?

Mr. Shonyo. Yes, that—I must say that is one of the major barriers that we face, particularly in Japan. The Japan copyright law is—it's a very difficult one to deal with, even for the Japanese. And—and just the fact that clearance must be obtained from, say, every author of an article or a paper, his affiliated organization's or sponsoring organization's. This fact is used very often to delay the access of information into NTIS.

Mr. **Walgren**. It strikes me that the reason that NITS sells the documents was not designed to limit access, was it? It was designed to try to produce some revenue.

Mr. **Shonyo**. That's correct.

Mr. **Walgren**. And so that seems to be a relatively artificial barrier to the range of NTIS and, in fact, a barrier that most people would be surprised existed?

Mr. **Shonyo**. Yes, well, it's—the program, the Foreign Technology Acquisitions program, has been operating within the framework of NTIS, which, of course, has in the past 10 years, been a self-supporting organization. It's just—it hasn't really been—the foreign program hasn't been set aside to that extent.

Dr. **Merrifield**. That's a good point, that there's a limit to the rate of growth based on the revenues that can be generated each year. And, of course, those have—have quintupled, I guess, over the last several years. But that's still from a very small base and—and the catalytic effort to make it happen faster could probably generate more revenues but it would run—result in a negative cash flow in the interim, which is not legally possible.

Mr. **Walgren**. Which is what?

Dr. **Merrifield**. Which is not possible, given the constraints on the total budget situation. So that—that is a constraint that has to operate on a—as the NTIS picks up this—this level of effort, and I think it will pick up. I think the sensitivity to a need is growing, but still it sort of just helps to be on a self-sufficient——

Mr. **Walgren**. Yes.

Dr. **Merrifield** [continuing]. Self-supporting basis.

Mr. **Walgren**. But, but where did that constraint come from, that it had to be self-supporting?

Dr. **Merrifield**. Well, the revenues—the—Joe, why don't you answer that?

Dr. **Caponio**. Yes. The—the basic mandate that the National Technical Information Service be self-supporting or self-sustaining to the extent feasible derives from the Congress. This is a congressional mandate, that we be self-supporting to the extent that we are able to offset the entire operating costs through the revenues derived from the sale of our information services and products.

This is not to suggest that this mission of the mandate could not be changed.

Mr. **Walgren**. Wouldn't it be wise to recommend such a change, if we truly see this as an area of great national need? We all know that you have to spend money to make money, and right at the beginning, that part of the curve is exactly where we should be spending the money.

Dr. **Merrifield**. Well, that's a good point, and we've been recommending a revolving fund, $5 million, which would allow us to do exactly that. And so far we haven't been—that hasn't happened. But that would make it go a long way to—allowing this to happen.

Mr. **Walgren**. I think some of that responsibility lies here and, in fact, I spoke to Mr. Dingell today about that exactly. I think we are remiss somewhat.

I wanted to say that we ought to at least introduce into the record your quote in Business Week, Dr. Merrifield, about the fact, as you say, "we are not doing an adequate job of translating, much less monitoring."

Dr. **Merrifield**. That's right.

Mr. **Walgren**. And "that there is a real need to do this all over the world but the apparatus and the funding are not there." And I would take it that there is no qualification by you of that statement?

Dr. **Merrifield**. No, indeed, I think that's an urgent need.

Mr. **Walgren**. OK.

Well, thank you very much.

Let me recognize Ms. Bach, the Subcommittee minority counsel, and I am going to excuse myself at this point or I will be ruled out on a vote. But go ahead and——

Ms. **Bach**. I just have a quick request that we submit the entire Business Week article as opposed to just a quote.

Mr. **Walgren**. OK.

[The article to be furnished follows:]

[From the Business Week, Feb. 13, 1984]

America Starts Looking Over Japan's Shoulder

U.S. INDUSTRY AND GOVERNMENT BELATEDLY BOOST THEIR MONITORING OF JAPANESE TECHNOLOGY

No one has kept closer tabs on new U.S. technology than the Japanese. When they began showing up en masse at U.S. trade shows and scientific meetings in the 1960s, the dark-suited Japanese businessmen, who listened intently to their interpreters and took photographs, were an amusing sight to many Americans. But their intense interest became far less entertaining when Japanese products based on the latest U.S. technology started flooding the U.S. market.

Now a growing group of experts warns that the U.S. must reverse the process to remain competitive. Both the quality and the quantity of Japanese research and development seem to be moving up smartly. "We have not taken advantage of the high-technology information that is available in Japan," says William F. Finan, special assistant to the Commerce Under Secretary for international trade. "If we fail to act, we are condemning ourselves to fall further and further behind the Japanese."

Similar concern was expressed recently by the American Chamber of Commerce. A study by the chamber's Tokyo office concluded that U.S. technology was rapidly being overtaken by the Japanese in 12 important areas, including advanced ceramics, optical fibers, and large-scale integrated circuits. That report prompted the U.S. embassy in Tokyo to fire off an urgent cable to the State Dept., pointing out that "the outcome for U.S. industry could prove devastating if the chamber's enumeration of technologies at risk is even half correct." The embassy strongly recommended that the federal government imitate Japan's massive system for gathering technological information and make it available to U.S. companies.

"National priority." Now the government is about to take its first step. The House subcommittee on science, research, and technology plans in March to call in represenatives of industry, academe, and government to explore ways to improve U.S. surveillance of Japan's laboratories. This effort "ought to be a national priority," says one government official. U.S. industry is also starting to move. At least one U.S. trade group, the American Electronics Assn. (AEA), plans to set up a listening post in Japan.

Matching Japan's information gathering network will be a formidable task. A top priority at all overseas offices of Japanese trading companies is to pass along any news of technical and market developments to their corporate customers in Japan. The Japanese government also finances the Japan External Trade Organization's many offices, which collect technical data. Industry associations, such as the Electronics Industry Association of Japan, maintain foreign offices to gather technical information. "Americans aren't organized to do that kind of information gathering," says Warren C. Hegg, a department head at the Tokyo office of SRI-Asia International, the Far East arm of the California think tank.

The Japanese, however, have had a long time to hone their data collection skills, while the U.S. is just beginning to realize that staying competitive with Japan entails paying more careful attention to Japanese technology. Many Japan-watchers in the U.S. believe Americans were blinded to the buildup of Japanese technology by a "not-invented-here" attitude. "We suffer from intellectual arrogance—the outdated feeling that America is preeminent and need not worry seriously about foreign competition." says Finan of the Commerce Dept.

But there is an increasing amount of technology to follow in Japan. It has significantly boosted its R&D spending in recent years. By 1981—the most recent year for which figures are available—Japanese R&D spending topped $26 billion—four times the amount it was spending annually 10 years ago. By contrast, civilian R&D in the U.S. in 1981 was about $52 billion, putting Japan close to parity with the U.S. on a per capita basis. Japan spends almost nothing on military research and development, while nearly 25% of the U.S. R&D budget is defense-related.

LANGUAGE BARRIER

Collecting data on that growing amount of Japanese research will be no simple task. While half of U.S. research is conducted at universities and is published, most Japanese researchers are employed by industry, and their work is not released. At the same time, few of the Japanese-language scientific journals are indexed.

Another problem for U.S. scientists is language. While many Japanese scientists can read English, few Americans are able to read or speak Japanese. Although English has become the language of science in Europe, only 25% of the Japanese scientific papers are published in English because their intended audience is other Japanese scientists. "This is the first time we have had to deal with an Oriental language—and an extraordinarily difficult one at that," comments Arthur Corte, a technology director at the State Dept.

U.S. efforts to monitor Japanese technology are scattershot at best. The Commerce Dept. has contracted with the Mitsubishi Research Institute to collect scientific documents for entry in its National Technical Information Service (NTIS) data base. Of the 70,000 titles now listed in that data base, however, only 800 are from Japan, compared with 16,000 European titles. The National Science Foundation maintains just one representative in Tokyo, and the U.S. embassy has only one science attaché.

Most avid of the Japan-watchers in the U.S. are the military and the Central Intelligence Agency, but their efforts, too, have been small and most of the data they collect is not available to the private sector. "It is not the Navy's responsibility to keep U.S. commercial interests informed," argues Kenneth W. Lackie, assistant for international and special programs at the Office of Naval Research, "We're not trying to help RCA build better TV sets."

Left to their own devices, such companies as RCA, 3M, Corning Glass, and IBM have set up their own information gathering operations through their Japanese sales representatives or their partners in joint ventures. In Japan, RCA Corp. maintains a staff of four, which carries out two jobs: translating scientific papers and reports and answering requests for technical data from company scientists in the U.S. A comparable International Business Machines Corp. operation screens the technology reported in periodicals, technical journals, and in papers presented at meetings of industry associations and professional societies.

These small staffs are often unable to keep up with their home offices' demands. And frequently these groups, as well as those from federal agencies, end up translating the same information. "There is a lot of duplication of effort," concedes an official of one major U.S. company with offices in Japan. Last year the National Aeronautics & Space Administration, the Commerce Dept., National Library of Medicine, the Army, the Office of Naval Research, and the National Science Foundation (NSF), were astonished to learn that they were all using a data base managed by the Japan Information Center for Science & Technology—and each was paying separately for much of the same material to be translated into English.

A POTENT SYMBOL

The AEA, which plans to set up a Tokyo office to monitor Japanese technology, is trying to interest other trade groups, such as the Semiconductor Industry Assn. in participating. "The Japanese will see that office as a symbol that their markets are extremely open," says Ralph J. Tomson, a senior vice-president at the AEA. The California-based group, which represents some 2,400 U.S. electronics manufacturers, hopes to get a grant from the Commerce Dept. to help finance the office's first two years of operation.

Commerce and the NSF have already decided to provide $500,000 to fund a program to evaluate Japanese technological strengths in such areas as computer design, robotics, biotechnology, and promising new semiconductor materials. The NSF will also send several scientists to Japan annually to prepare reports on research in their disciplines. The House subcommittee is looking for ways to coordinate the information gathering operations in the federal government, possibly by recommending that NTIS or the National Bureau of Standards be designated the lead agency.

A handful of small, enterprising U.S. companies are already monitoring Japanese technology on their own. Paul Richman, chairman and president of Standard Microsystems Corp., for example, spends a great deal of his time in Japan, where he has patent licensing agreements with such powerful Japanese competitors as Toshiba, Hitachi, Fujitsu, and NEC. The founder of the 12-year-old, Hauppauge (N.Y.) semiconductor maker reads every U.S. patent that is issued to a Japanese company in semiconductor technology. "Things are definitely changing; the Japanese have achieved parity with us in a number of areas, and that can put us at a distinct disadvantage," says Richman.

COSTLY DELAY?

Some universities are also beginning to recognize the need for closer ties between U.S. and Japanese researchers. "If we are going to compete as equals in science and technology, we have to understand the Japanese as well as they understand us," says Richard J. Samuels, director of the Massachusetts Institute of Technology-Japan Science & Technology Program. The joint program, set up in 1981, provides annual grants to about seven students who spend one year working in corporate, government, and university laboratories in Japan.

Developing that kind of understanding, however, is likely to take time. Many experts are worried that such a delay could cost the U.S. its lead in critical technologies. They are now calling for funding to set up a coordinated government effort to gather technical data, mainly from Japan but from other countries as well. Says D. Bruce Merrifield, Assistant Commerce Secretary for productivity, technology, and innovation: "We are not doing an adequate job of translating, much less monitoring. There is really a need to do this all over the world now, but the apparatus and the funding aren't there."

Mr. **WALGREN**. But it will not change the meaning of that quote and I hope that it is not lost on everybody as a direct statement of inadequacy in an area where we can argue that the national well-being is clearly at stake.

Well, let me thank you all for coming and we will be talking to you more about this area in particular. It's one of great interest to us; I know that you are interested in it, too. And I hope together we can take some strong steps forward.

Dr. **MERRIFIELD**. Thank you, Mr. Chairman.

Mr. **WALGREN**. Thank you.

Tomorrow the hearing will start at 9:30.

[Whereupon, at 5 p.m., the subcommittee recessed, to reconvene at 9:30 a.m., Wednesday, March 7, 1984.]

THE AVAILABILITY OF JAPANESE SCIENTIFIC AND TECHNICAL INFORMATION IN THE UNITED STATES

WEDNESDAY, MARCH 7, 1984

House of Representatives,
Committee on Science and Technology,
Subcommittee on Science, Research and Technology,
Washington, D.C.

The subcommittee met, pursuant to recess, at 9:40 a.m., in room 2325, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Members present: Messrs. Walgren, Mineta, Valentine, Boehlert, Sensenbrenner, and Skeen.

Mr. Mineta [presiding]. The Subcommittee on Science, Research and Technology will please come to order.

Today the Science, Research and Technology Committee continues hearings to investigate the availability of Japanese scientific and technical information in the United States. I'd like to express my personal appreciation to the chairman of this subcommittee, Mr. Walgren, and to the subcommittee staff and consultants for arranging these hearings.

As a result of these hearings we have a wonderful opportunity to develop some appreciation for the range of information and data which exists in Japan today. Moreover, we can use this time to explore ways in which this information can be collected and disseminated in our own country.

For many years, I have hoped we would come to the point where we would recognize the need for a systematic collection of information developed beyond our own borders. During the Korean war, I served as an interpreter-translator for the Armed Forces in the Far East in the 8th U.S. Army. At that time I became keenly aware of how critical it was to have a group of able translators with the ability to transmit information on a timely basis.

The information we seek today is scientific and technical data but it, too, is valuable, and should be made available to our research and industrial communities on a regular basis.

When we conclude these hearings, I am hopeful that we will have a better sense of how the Government might assist in this endeavor.

So now I would like to welcome our first witnesses, a panel. If I could ask everyone to come forward at this one time, Dr. John A. Alic, Project Director, Office of Technology Assessment, accompanied by Dr. Martha Caldwell Harris; and Mr. Peter Marino, Deputy Director, FBIS, Foreign Broadcast Information Service, accompanied by Cyril Braegelmann, Chief, Near East/Asia Division of FBIS.

We are pleased to have all of you here. We have your written testimony and that will be made a part of the record. So, Dr. Alic, if you would go ahead and proceed in your own fashion.

STATEMENTS OF JOHN A. ALIC, PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT, ACCOMPANIED BY MARTHA CALDWELL HARRIS, AND PETER A. MARINO, DEPUTY DIRECTOR, FOREIGN BROADCAST INFORMATION SERVICE, ACCOMPANIED BY CYRIL P. BRAEGELMANN, CHIEF, NEAR EAST/ASIA DIVISION, FOREIGN BROADCAST INFORMATION SERVICE

Dr. Alic. Thank you. It's a pleasure to be here. I'd like to thank the subcommittee for asking OTA to testify on this very important subject.

I'll summarize briefly the main points of my prepared statement this morning. It's based on OTA's ongoing efforts investigating international competitiveness of American industries.

With me today is Dr. Martha Caldwell Harris who's been a member of the OTA staff working on our studies of competitiveness.

Much of our work has involved United States-Japan comparisons. These demonstrate quite clearly that the United States can learn a great deal from Japan's technology and science.

They also show that this will not be easy. Despite all the publicity given to Japan's economic miracle, too many Americans still look for simple explanations of Japan's successes: cheap labor, cheap capital, government subsidies, favorable exchange rates, labor-management cooperation, copying and commercializing American innovations.

In technology, however, shortcuts are few. Simple answers are rare. Developing succesful commercial products and processes takes hard work, commitment, and high level technical skills. These, Japan has, in abundance.

I have three main points about technology and about Japanese technology before going on to the question of information from Japan itself.

The first of these points is that the Japanese are excellent technologists. They are highly creative and they are steadily getting better.

My prepared statement amplifies on this point at some length with examples from the industries that we've studied.

The second point is that people develop technology; people transfer technology. Print media, books, technical papers, computer programs, conferences, visits to factories and laboratories—these are the starting point. They are important but it is people working with the technology that counts in the end.

To learn very much from Japanese technology, you need to do something with it.

The third point is that although private companies will be the primary users of Japanese technology and information on Japanese technology, the Federal Government can, and should, help make information and analysis dealing with Japan's technology and science available in the United States.

I will suggest in a moment several ways the Government could do this.

Let me now turn to the question of how the United States can learn from Japanese technology and science.

First of all, it's clear that many American businessmen have quickly developed a sophisticated appreciation of the lessons to be learned from Japan. But at the same time, I think that those American firms, large and small, who are actively seeking expertise and know-how from Japan are in the minority.

American industry includes tens of thousands of companies, many small, but also some large companies, that are far from self-sufficient technologically. They need to go outside for help in commercializing products; for help with manufacturing processes. Many of these companies could benefit from sound technical information regardless of whether it originated in Japan or, indeed, in the United States.

I will not go into the needs of such companies further at this time. OTA addresses the subject at some length in a staff memorandum entitled "Development and Diffusion of Commercial Technologies: Should the Federal Government Redefine Its Role?" which we expect to release in a week or so.

I would be pleased to submit a copy of that memorandum for the record of this hearing when that memorandum is available.

Mr. MINETA. The committee record will remain open to accept that.

Dr. ALIC. Thank you.

[The memorandum to be furnished follows:]

Staff Memorandum

DEVELOPMENT AND DIFFUSION OF COMMERCIAL TECHNOLOGIES: SHOULD THE FEDERAL GOVERNMENT REDEFINE ITS ROLE?

Industry, Technology, and Employment Program
Office of Technology Assessment
United States Congress

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DEVELOPMENT AND DIFFUSION OF COMMERCIAL TECHNOLOGIES: SHOULD THE FEDERAL GOVERNMENT REDEFINE ITS ROLE?

The Subcommittee on Economic Stabilization of the Committee on Banking, Finance and Urban Affairs has asked OTA to examine the need for new or improved mechanisms for developing commercial, as opposed to military, technologies and/or diffusing them to U.S. industry. In particular, the Subcommittee asked for OTA's comments on H.R. 4361, the Advanced Technology Foundation Act. However, as the letter of request from the Subcommittee's Chairman (see the appendix) makes clear, the Subcommittee wanted OTA to look rather broadly at R&D and its diffusion, not only at the details of H.R. 4361.

Briefly, OTA's analysis indicates that an Advanced Technology Foundation as provided for in H.R. 4361 could be a major step in deepening and broadening the technological foundations for U.S. industry. Later in this Memorandum, OTA points out a number of ways in which the bill might be strengthened. Perhaps most important, H.R. 4361 could explicitly provide for a network of technology centers charged with developing and diffusing commercial technologies. Over the years, many studies, conducted within the Federal Government as well as externally, have established the need for such a network. The knowledge and experience to begin building it exists, should a decision be taken at the Federal level to proceed.

The analysis in this Memorandum builds on a series of OTA studies of the competitive standing of U.S. industries, principally U.S. Industrial Competitiveness: A Comparison of Steel, Electronics, and Automobiles (July 1981) and International Competitiveness in Electronics (November 1983). The reasoning behind the findings below starts with two major points. First, military needs dominate Federal R&D expenditures. This year, fully 70 percent of the Government's R&D dollars will go toward defense-related technologies. Priorities determined by the Department of Defense set research agendas in aerospace and in many electronics firms; they also have a good deal of influence in universities. Technological spinoffs from military and space projects funded by Government or conducted in Federal laboratories tend to be long-term and indirect. While these spinoffs sometimes lead to major classes of new commercial products or processes, serendipitous results can neither be planned nor guaranteed.

Second, development of new technologies is a fundamentally different activity from scientific research. Technology and science are linked in many ways, tightly in some field, loosely in others. Even where the inter-relationships are close, the two activities are unique and more or less independent of one other. Sometimes new commercial products or processes flow from or depend on scientific advances. Lasers are one example. Elsewhere, scientific research depends on technology. Examples include much of space science, as well as applications of powerful computers in unraveling the structures of DNA molecules. Not uncommonly, technologies outstrip the underlying science. As a result, the Federal Government cannot assume that expenditures for scientific research will automatically translate into the commercial products and processes vital for an internationally competitive economy. This often happens, but not always. If the Federal Government wishes to support commercial technology development, it must do more than support research. Support for commercial technologies need not imply Government involvement close to the marketplace.

A related point emerges from the section below entitled "Technology and Science." Despite the common perception, processes of technology development seldom follow a linear progression from research to development to commercialization and production. Sometimes new knowledge in the form of research results or specialized expertise that may not be widely diffused within the technical community is needed at the beginning of a development project. (Developing a new product or process often takes five years or more.) In other cases, such knowledge will prove critical near the end of a project. Typically, research enters the process at multiple points. Moreover, the great majority of American firms, large as well as small, lack the resources to be self-sufficient in technology and science. The complexity and pace of modern technology have simply outstripped their ability to keep up. Institutional mechanisms for technology development and diffusion -- transferring know-how and research results to those in industry who need them -- must not only be flexible, they must be capable of responding to widely varying needs at different stages in development and commercialization.

FINDINGS

Policy Alternatives

OTA has examined three suggestions for Federal initiatives in technology development and diffusion: H.R. 4361, the Advanced Technology Foundation Act; a National Technology Foundation (or National Engineering Foundation); and a civilian agency analogous to the Defense Research Advanced Projects Agency (DARPA). These alternatives, which overlap considerably in their objectives, come nearer to being complementary than exclusive. In summary, OTA finds that:

a) H.R. 4361 could effectively bridge the gap between basic research and commercialization through its support for generic technologies and technology diffusion. The Advanced Technology Foundation which the bill would establish might nonetheless be more effective if modified as outlined in the concluding section of this Memorandum (pp. 45-50). In summary, OTA's analysis indicates that H.R. 4361 could be strengthened by including explicit provision for a network of technology centers, linking these centers to the Federal Industrial Extension Service authorized in Sec. 7 of the bill, supplying direct funding to the States for extension programs, transferring responsbility for engineering research to the ATF, and including provision for an Office of Foreign Technology charged with collecting, analyzing, and disseminating scientific and technical information originating overseas.

b) A National Technology Foundation, which would take over responsibility for basic engineering research from the National Science Foundation, could, by focusing resources on technical problems relevant to civilian manufacturing industries, prove a significant source of long-term strength for the U.S. economy. Substantially higher priorities for engineering research appear unlikely within NSF as presently constituted. If, however, the National Science Foundation were restructured and its commitment to engineering strengthened sufficiently, it would be preferable for engineering research to remain an NSF responsibility.

c) A civilian DARPA, as a Federal agency charged with commercially-oriented technology development but divorced from the marketplace, could easily founder on the intrinsic difficulties of selecting projects for support.

These policy-related findings are based on OTA's analysis of the existing R&D system and the needs of commercial industries, summarized below.

The Existing System

1. When Government is the end user of new technology, as is the case for military systems, Federal support for R&D is relatively straightforward. An extensive array of institutional mechanisms exists for funding and conducting activities ranging from pure science to the design, development, and manufacture of new weapons. The procedures may not be perfect, but

they work. When the primary objective is commercial technology development, the Federal Government has a relatively narrow range of experience to draw on -- much of it less than successful -- and a limited array of institutions and mechanisms.

2. The United States remains without peer when it comes to science; despite the strong emphasis on military R&D sponsored by Government, few signs point to any need for major change or institutional innovation at the basic research end of the R&D spectrum. Even so, basic research that would support the international competitiveness of U.S. industries ranging from steel to automobiles to electronics has sometimes been lacking. Gaps in research stem mostly from conscious choices by industry and the Federal Government. The existence of such gaps points to the need for continued attention to priorities and funding levels.

3. The hundreds of laboratories operated and/or funded by the Federal Government comprise a vital resource for scientific research and for the development of defense-related technologies. Even so, the National laboratories are unlikely to play more than a marginal role in the development and diffusion of commercial technologies. This has not been their mission; attempts to reorient their activities would be unlikely to have more than limited success.

4. In contrast to military R&D, where Government is the customer -- and despite the successes of industrial policy programs directed at commercial

technologies in several foreign countries -- direct involvement of the Federal Government in the development of commercial products and processes has not in the past fit comfortably into the U.S. political and economic system. A greater degree of such involvement might evolve over time from an approach emphasizing generic, pre-competitive technology development. However, this need not be an objective.

Commercial Technology

1. Many American companies, large and small, have ample resources and know-how to exploit technologies developed internally or acquired from other sources. This is true for some but not all relatively small entrants in fields such as biotechnology or microcomputer software as well as for multinationals like IBM or Hughes Aircraft. Any additional support provided by the Federal Government would be useful to such companies, but is not vital.

2. Although many "high-technology" enterprises, along with firms in more traditional industries, can learn what they need to know, other American companies -- indeed, the vast majority -- are far from self-sufficient. They lack critical pieces of the technical puzzles they must solve. Some large and powerful firms may find their competitiveness declining, perhaps because of lagging technological capability. Smaller organizations may have neither the financial nor the human resources -- sometimes a single person with critical technical skills -- to capitalize on know-how in

principle available to them.

3. Helping American firms acquire and make use of technology, newly developed or existing, could create new jobs and benefit the international competitiveness of U.S. industry. Examples of technological areas that would benefit a range of industries include research in advanced manufacturing methods and computer engineering. Foreign technologies, particularly from Japan, could also help many American firms; access could be improved through the establishment of a system for evaluating and disseminating information on Japanese science and technology.

4. Domestic companies could benefit from improved mechanisms for the diffusion of technology within the United States. They could also benefit from programs aimed at development of generic technologies with broad commercial relevance. Examples include: applied research in microelectronic devices; combustion processes and automobile safety; disciplines such as engineering design; the science base for manufacturing; common technical concerns such as lubrication and wear or structural integrity.

5. Initiatives in the private sector such as the Semiconductor Research Corporation and Microelectronics & Computer Technology Corporation demonstrate the need for new approaches to pre-competitive R&D even among the leaders of high-technology industries. When such initiatives are funded, planned, and conducted entirely by private firms, their time

horizons will not differ much from those for R&D within the companies themselves. Participation by the Federal Government could extend these time horizons to projects with longer payback periods.

The Federal Role in Development and Diffusion of Commercial Technologies

1. The Government's past attempts to develop and diffuse commercial technologies should be regarded largely as experiments -- some successful, some not. Important lessons can be learned from failures and partial failures as well as successes. A continuation of the experimental approach, one in which mistakes are both permissable and inexpensive, is desirable.

2. Mechanisms for the development and diffusion of commercial technologies work better when flexible and decentralized. Many States already operate technology extension services, some much more highly developed than others. Emphasizing local initiatives can speed response to the needs of firms and industries in a given State or region. State universities are a logical source of resources and knowledge to support programs which seek to help companies utilize new as well as existing technologies.

3. Technologies are transferred and diffused largely by people. Technical reports, patents or licenses, conferences can all be important, but are generally only starting points. Federal support for commercial

technology development and diffusion might therefore focus on building networks of technically trained people. The Federal role might encompass the following:

a) Providing on a continuing basis funds to the States earmarked for technology diffusion -- e.g., for technology extension services.

b) Funding, again on a continuing basis, for centers with missions encompassing both development and diffusion of commercially-oriented technologies. (This would be independent of extension activities.) The development mission could concentrate on pre-competitive activities -- beyond the stage of scientific research but still well-removed from the marketplace. Centers with a dual mission of development and diffusion are already authorized by the Stevenson-Wydler Act (P.L. 96-480), which directs the Department of Commerce to establish an Office of Industrial Technology and a network of Centers for Industrial Technology. The centers would link developers and users of technology in industry, universities, and Government, State as well as Federal.

c) Following the precedent established by the National Science Foundation's cooperative research centers and innovation centers, the approach should be one of experimentation and adaptive learning to find mechanisms that function effectively. Some centers could be organized on a technology-specific basis -- e.g., centers for computer-integrated manufacturing or human factors engineering. Others could be organized on an industry-specific basis -- e.g., centers that would support development and diffusion of technologies relevant to the steel industry, the general aviation industry, the automobile industry.

d) Establishment of a system for collecting, analyzing, and disseminating technical information from other countries, particularly Japan and the Soviet Union. The need begins with translations of technical literature. It extends to exchange programs for engineers and scientists, as well as Federal efforts to speed inward flows of technology through licensing and other technical exchange agreements. Information on Japan's technology and science is particularly critical. The capability of Japan's firms and the importance of learning from their technology is illustrated by by the General Motors' proposed joint venture with Toyota. General Motors spends more money on R&D than any other U.S. corporation, yet one of its objectives is to acquire Japanese know-how.

SUMMARY

The Subcommittee's primary questions were: Is there a need for a strengthened Federal role in the development of new commercial technologies? Are better mechanisms for diffusing commercially relevent technologies to industry needed? What are the Federal Government's options in undertaking either or both of these activities? OTA's answers are summarized below.

Many small to medium-sized U.S. firms -- and a surprising number of large corporations -- lack critical ingredients for successful commercial product and process innovations. Sometimes this is money or marketing ability, but in many cases vital pieces of technical knowledge are missing. Because technical know-how is typically embodied in people, a company may not even know that it is missing a piece of the puzzle: no one with the needed perspective can be found within the organization. Sometimes the missing link consists of people with background that would equip them for learning to do something. In any case, the need is generally to bring the right kind of knowledge to a given problem; this is more difficult than it may seem because the problem will often be narrowly defined, requiring highly specialized expertise.

The technology base for U.S. industry is complex and rapidly expanding. New fields such as digital systems design or structural integrity technology grow to relative maturity in the space of a decade or two. Thus it is no surprise that organizations as much as individuals have trouble keeping up. OTA's analysis points to the need for a more active Federal role in facilitating the generation and diffusion of technical knowledge to business and industry.

Traditional justifications for Government participation have emphasized the support of R&D with social returns exceeding private returns. To this and other benefits commonly associated with "innovation" can be added a newer element: helping companies make use of new and existing technical knowledge to improve the international competitiveness of U.S. industry. Business executives sometimes deny the need for new approaches. There are several reasons. Some have a generalized fear of greater Federal involvement. Some speak for self-sufficient enterprises, large and competitive, with ample resouces to keep up; such firms may suspect that their rivals will reap greater benefits. Others have failed to realize they have a problem, else they might have moved to remedy it themselves.

In sum, OTA finds a strong case for institutional innovation aimed at "greasing the wheels" for commercial technologies. A flexible and adaptive network, with ample room for local control and local intitiatives, seems most appropriate. The Federal role could be threefold:

- providing leadership and visibility, as part of an industrial policy aimed at strengthening U.S. competitiveness;

- coordinating and linking the network of largely autonomous centers that seem the most appropriate vehicle for technology development and diffusion;

- providing partial funding for these centers on a continuing basis, ensuring not only stability but time horizons longer than those of private corporations.

The last point could be of particular significance. Most firms support R&D with relatively short payback periods; while large companies in the United States have sometimes established corporate research laboratories to conduct projects with longer time horizons, many such efforts have been scaled back or eliminated over the past fifteen years. In part for such reasons, gaps in R&D exist in many technologies, particularly those well removed from military needs or having prospective applications that seem too far in the future.

Some R&D gaps can be found in relatively fundamental areas: theoretical foundations for software engineering, process control models for the fabrication of microelectronic devices. Others occur in more applied fields, closer to the marketplace but still "pre-competitive": combustion phenomena in automobile engines, control system models for robot arms that include nonlinearities and inertia effects. Many examples in manufacturing, a field that badly needs to be moved into the mainstream of engineering science, could be cited.

A relatively broad range of options exists for stimulating commercially oriented R&D that could help fill such gaps. One of the most straightforward steps would be to increase priorities within the Federal Government for basic research in engineering. While many commercial technologies depend on such research, engineering research in the United States suffers relative to basic science; this is one reason among many for lags in U.S. competitiveness.

A common suggestion for giving engineering greater priority has been to remove the responsibility for research in engineering from the National Science Foundation, transferring it to a National Technology Foundation or a National Engineering Foundation. Such proposals reflect the feeling, now rather widespread, that reorganization of NSF to emphasize engineering, or allocating more money for technology within the Foundation, would not go far enough. OTA's analysis indicates that, while removing engineering from NSF would risk isolating engineering from science, this risk is small compared to the potential benefits. On the other hand, a restructuring of NSF -- perhaps in the form of a National Science and Technology Foundation -- would be a more attractive option provided that the restructuring guaranteed sufficient resources for engineering.

It is also possible to envision a civilian agency that would focus on long-term commercial R&D much as the Defense Advanced Research Projects Agency (DARPA) does for military R&D. Like the rest of the Department of Defense, DARPA is mission-oriented. Defining an appropriate mission for a parallel civilian agency would be difficult, for reasons outlined in the section on "Policy Implications" below.

If targeted development of commercial technologies, even those having long time horizons, seems a problematic activity for the Federal Government, broadening and strengthening the existing system, now small in scale, of Federally-supported centers for generic and cooperative R&D seems a wholly appropriate step. Many more such centers -- decentralized, and with individually modest budgets -- could be established to fill research gaps on both a technology-specific and an industry-specific basis. OTA suggests that this approach be made part of H.R. 4361.

Processes of technology development and diffusion overlap. The Federal Government might seek to encourage both, with diffusion viewed as integral to the mission of all or most technology centers. The centers could transfer technologies directly to the private sector, as well as to the technology extension services which a number of States are developing. (It seems appropriate for the Federal Government to support and help fund State efforts, but not to duplicate them.)

As long as they function successfully, technology centers should receive Federal dollars on a continuing basis. This is a major point of difference with existing programs responsive to the Stevenson-Wydler Act. If totally or too heavily dependent on funding from industry, time horizons will approximate those of private corporations. Many of the gaps such centers should be filling arise because of the relatively short-run objectives of industrial managers, and because private sector goals tend to diverge from broader social objectives. For example, despite the high social costs of automobile accidents, remarkably little R&D concerned with automobile safety goes on outside the automotive industry. (The National Highway Traffic Safety Administration is primarily concerned with regulatory compliance.) To stimulate innovation and competitiveness, and to promote social objectives, a stable pattern of Federal funding is needed.

INTRODUCTION

Science and technology in the United States comprise a vast and amorphous set of activities. Government and the private sector together will spend nearly $95 billion on R&D in 1984, employing about three-quarters of a million engineers and scientists, plus many technicians and others with supporting roles.[1]

In November 1983, OTA delivered to the Subcommittee on Economic Stabilization a Memorandum entitled "R&D In The United States and In The Other OECD Countries." That Memorandum stressed the vigor of government activities in Japan especially, and also in West Germany, intended to stimulate commercial technology development. In contrast, the U.S. Government's R&D spending is heavily weighted toward defense-related technologies: fully 70 percent of 1984 Federal R&D funds -- $30 billion of the $43 billion total -- will go toward military projects. While the latter have often had significant spinoffs in the civilian economy -- semiconductor electronics and fiber-reinforced composite materials among the more visible examples -- such spinoffs are unpredictable.

Not only do military projects dominate the Federal R&D budget, health-related research, another large component, likewise overshadows

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[1] Here and elsewhere in this Memorandum, 1984 R&D spending estimates come from Probable Levels of R&D Expenditures in 1984: Forecast and Analysis (Columbus, Ohio: Battelle Memorial Institute, December 1983). The figures are on a calendar year basis.

Government support aimed at goods-producing civilian industries. Federal support has increased over the past few years for basic research in the sciences, also of unquestioned importance. But again, such research affects commercial product and process developments only indirectly and at long range. If the Government should decide to support and encourage technology development for non-military goods-producing industries, how should it go about the task? That is the question addressed in this Memorandum.

While the United States has a modest store of experience to bring to this question, much of it in energy R&D, the Nation's approach to the conduct of military-related R&D and basic scientific research is far better developed. Relative inexperience in commercially-oriented R&D is at least partially balanced by the possibility of developing new institutional mechanisms unencumbered by the detritus of the past.

Drawing heavily on OTA's studies of the international competitiveness of U.S. industries, this Memorandum focuses on the manufacturing sector, which accounts for about 95 percent of industrial R&D. The Memorandum is organized as follows. The next section gives a summary picture of interactions between military and civilian R&D. A brief overview of the R&D system in the United States follows, outlining Federal expenditures by category and describing the context within which an Advanced Technology Foundation or similar institution would operate -- a context which already includes a far-flung array of Federal agencies and laboratories that fund and/or perform R&D. The next section contrasts two related but distinct activities: scientific research and technology development. The discussion raises several questions of some import for policymakers: In what ways does technology depend on science? Where, in the development, commercialization, and manufacture of a particular product does "research" come into play? The last section of the Memorandum examines H.R. 4361, the Advanced Technology Foundation Act, along with two other approaches to stimulating commercial technology development in the United States.

MILITARY AND CIVILIAN R&D

In many fields, military and commercial technologies will no doubt continue to diverge, as they have in advanced electronics -- where defense systems now lag well behind civilian applications. This lag has motivated the Pentagon's Very High-Speed Integrated Circuit program. In other technologies -- e.g., supersonic aircraft -- military designs hold few obvious lessons for the commercial industry; at a time when high performance in the sense of speed, maneuverability, and range continues to be primary in military aircraft, the civilian market demands improved fuel efficiency and less noise.

Where military R&D continues to stimulate civilian product and process developments, one of two conditions typically holds: (1) the military stimulus arises from long-term, relatively basic research; or (2) the particular technology, for whatever reason, is relatively close to that applicable on the civilian side of the economy. The first case, exemplified by DoD (Department of Defense) funding for R&D on compound semiconductors such as gallium arsenide, which goes back to the 1960s, typically results in spinoffs that follow many years after the original work and are only loosely linked to those research outcomes. Gallium arsenide integrated circuits are just now entering the marketplace; microelectronics markets in the latter part of the 1980s are likely to be dominated by c-MOS (complementary metal oxide semiconductor) circuits, a technology in which military R&D played no role at all.

In the second case, because the linkages are closer, it is easier to find examples of spinoffs. Design techniques for aircraft structures evolve in parallel in the military and civilian communities. Defense agencies -- notably the Air Force -- support R&D on structural design and structural integrity, much of it within aerospace companies. Some work is also performed in the military's own laboratories and some is sponsored at universities. Results -- which in the case of an aircraft structure seldom depend on whether the plane is to be designed for subsonic or supersonic flight -- diffuse quickly to designers and analysts throughout the technical community.

On a somewhat more exotic level, the United States might expect the Strategic Computing Program of the Defense Advanced Research Projects Agency to generate modest spinoffs in the medium term, for reasons which differ from the aircraft example. Artificial intelligence remains a primitive technology. It is too early for prospective military and civilian applications to have diverged greatly. As the technology evolves, it will become more specialized. But at the moment, the "expert system" work contemplated by DARPA (the Defense Advanced Research Projects Agency) -- aimed at helping pilots fly their planes in combat, or providing advice and counsel for field commanders -- could have rather immediate impacts on emerging commercial applications.

While other such examples exist, the class of technologies important for National defense is far too narrow to provide consistent and cost-effective support for the Nation's commercial industries.

THE R&D SYSTEM

Research

In a modern industrial economy, research and development activities span a vast range. At one extreme lies basic research in which knowledge is pursued for its own sake. Some projects, as in elementary particle physics -- classic "big science" -- require large and complex organizations. Teams numbering many dozens may be funded at millions of dollars per year by the Department of Energy or the National Science Foundation. Space science or oceanography provide similar examples in terms of scale and complexity. At the same time, a single mathematician, driven by no more than his own curiosity and equiped with nothing beyond paper and pencil, can still make fundamental advances.

The individual theorist, staring out the window and thinking, like the team of scientists and technicians operating a particle accelerator, is conducting basic research. Both are in search of knowledge. This knowledge may have major implications for industry, but these normally lie far in the future. For many years, welds in pipelines and nuclear reactor pressure vessels have been inspected with x-rays, and soon x-rays will be used in fabricating integrated circuits, but such applications were hardly anticipated when x-ray technology was a new tool for studying atomic structure.

Development

Basic research -- whether aimed at the etiology of cancer or the fundamental structure of matter -- garners Nobel prizes, about 12 percent of total U.S. R&D dollars, and a good deal of media publicity. Still, the great majority of R&D consists of development. Here one finds groups of engineers, technicians, and scientists perfecting guided missiles, CAT scanners, and Olympic bobsleds. Although mostly routine product development, testing, and problem-solving, the range of such work is in its own way just as great as for scientific research. Breakthroughs -- the microprocessor, direct reduction processes for making iron -- come from engineering development as well as from science.

The Automobile Industry As An Example[2]

The automobile industry is not particularly research-intensive, but is heavily development-intensive -- in part a result of the annual cycle of new models. Automobile companies have traditionally been in the top ranks of U.S. companies in total R&D spending, although not nearly so high in terms of R&D as a percentage of sales. (The five firms spending the most in total R&D dollars during 1982, according to Business Week's annual survey, were General Motors, AT&T, IBM, Ford, and DuPont; while GM's R&D spending came to 3.6 percent of sales, IBM spent 6 percent.) Most R&D in the automobile industry consists of straightforward engineering -- designing and developing the cars to be built over the next five years. That the industry has conducted little basic research contributed to its difficulties in responding quickly to demands for reduced exhaust emissions during the 1970s. Some of the trial and error that characterized the development programs of the time might have been avoided if a more extensive research foundation in the fundamentals of combustion had been laid in earlier years.

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[2] OTA has discussed R&D in the steel and electronics industries at some length in its earlier Staff Memorandum, "R&D In The United States and In the Other OECD Countries.

Nor does the Federal Government perform or support much work that is directly applicable to automotive engineering. The Department of Defense conducts R&D on piston engines with multifuel capability, and on gas turbines, but this work is well removed from passenger car technology. Little research in automotive engines has been conducted in American universities since World War II, largely because neither industry nor Government has been willing to provide financial support; aerospace propulsion systems -- turbines, rocket motors -- became the focus of military R&D, hence more popular research subjects on campus. Indeed, many universities went so far as to delete the courses in internal combustion engines that had once been common.

Despite the underdeveloped state of basic research that might support automotive technology, the industry resisted the Cooperative Automotive Research Program (CARP) proposed in the late 1970s by the Carter administration. The intent was to support basic research with long term objectives in areas such as combustion and emissions control, occupant safety, vehicle mechanics, and aerodynamics. CARP, to have been funded at $800 million over 10 years, died after the 1980 election. Today, there are many signs in the engineering literature and in presentations at meetings of groups like the Society of Automotive Engineers that Japanese companies are undertaking more far-reaching and innovative engine research and development programs than their counterparts in the United States. The implication is plain. American automakers have had great difficulty competing on a cost basis with Japanese producers. If Japan develops a significant technological edge as well, U.S. competitiveness in this industry will slip even further.

Even in Japan, of course, most of each automaker's R&D spending goes toward design, development, and the extensive testing needed for its future product line. The creative engineering coming from Japanese automobile companies stems, not so much from investments in basic research as from development programs with objectives perhaps half-a-dozen years in the future. In some contrast to the automobile industry, U.S. or Japanese, electronics and communications firms like AT&T or IBM allocate greater fractions of their R&D dollars to basic research. Nonetheless, such firms also do a great deal of rather routine engineering development. Although precise figures are seldom available, basic research would almost certainly account for less than 10 percent of any company's R&D budget, whether that company was American or foreign.

Federal Support for R&D

As OTA emphasized its Memorandum "R&D In the United States and In the Other OECD Countries," the Federal Government's R&D expenditures are dominated by defense-related projects. (Perhaps a quarter of the Nation's most capable engineers and scientists are engaged in military R&D.) Estimates for 1984 calendar year R&D obligations by agency are given below.[3]

	1984 Obligations (billions of dollars)	Percentage of Total Federal R&D Obligations
Department of Defense	$27.5	64.5 %
Department of Energy	4.2	9.9
Health and Human Services	4.1	9.5
National Aeronautics and Space Administration	3.0	7.0
National Science Foundation	1.2	2.7
Department of Agriculture	0.77	1.8
Department of Transportation	0.47	1.1
Department of Commerce	0.21	0.5
Environmental Protection Agency	0.17	0.4
Other	1.1	2.6
	$42.7	100 %

Much of the Energy Department's R&D spending goes toward nuclear weapons; as a result, the military-related portion of the 1984 Federal R&D budget is expected to reach 70 percent. As the following table shows, defense and space therefore account for three-quarters of Federal R&D spending.

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[3] Battelle Institute's annual surveys, cited on page 17, have proven remarkably accurate in past years.

	1984 Obligations (billions of dollars)	Percentage of Total
Defense	$29.9	70.0 %
Health	4.1	9.5
Energy	2.2	5.1
Space	1.8	4.2
General science	1.6	3.8
Transportation	1.02	2.4
Environment, natural resources	0.73	1.7
Agriculture	0.68	1.6
Other	0.73	1.7
	$42.7	100 %

As recently as 1982, defense accounted for only 57 percent of the Federal R&D budget.

DoD's 1984 basic research budget totals something over $800 million, or about 3 percent of the Department's total for R&D — a percentage of basic research not unlike that commonly found in the private sector. The great majority of Federal dollars for military-related R&D go toward the development of weapons systems; these dollars buy engineering skills which do not differ greatly from those found in the civilian portion of the economy. The Government pays for about three-quarters of all aerospace R&D, and 40 percent in electronics and communications -- but only 15 percent of automotive R&D and less than 3 percent in the steel industry.

In contrast to DoD's emphasis on development, nondefense R&D spending by the Federal Government is heavily weighted toward basic and applied research. (The rather elusive distinctions among R&D categories are discussed in the section below on "Technology and Science"; also see Figure 1.) In 1984, basic and applied research, each totalling nearly $6 billion, will account for 70 percent of nondefense obligations. In 1978, the Federal nondefense R&D total was roughly 50 percent higher in real dollars, with nearly half the money going for development.[4] The Reagan administration has reduced funds for development and technology demonstration, while stressing basic research. Typical examples can be found in energy-related R&D, where conservation and solar energy have been heavily cut. Solar R&D went from a high of $570 million in 1980 to $178 million for 1984; even this figure was about twice the administration's request to Congress.

In 1984, Federal dollars will pay for about 45 percent of total U.S. R&D.

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[4] C. Norman, "The Reagan Budget: More of the Same," Science, February 10, 1984, p. 564.

The Government will perform a much smaller fraction of the total -- 11 percent (i.e., about a quarter of the Government's R&D dollars, or $10 billion, will be spent within Federal laboratories). Universities will account for another 11 percent, with industry conducting three-quarters of all R&D and nonprofit laboratories the remainder.

The National Laboratories

The $10 billion which goes to R&D performed by the Government pays for activities in more than 700 Federal laboratories.[5] These range from huge complexes such as NASA's research centers, the Air Force's Wright Aeronautical Laboratories, and the Department of Energy's Los Alamos weapons center -- to little-known complexes such as Panama facility of the Gorgas Memorial Institute of Tropical and Preventive Medicine. Depending on their missions, Federal laboratories may do mostly engineering development, typical for NASA, or may emphasize basic research, as in the Laboratory of Biochemistry of the National Cancer Institute. Many of the National laboratories fund external R&D programs in univerities and industry, while also conducting their own research.

No Federal laboratory has a mission emphasizing the development of commercial technologies, although R&D with near-term as well as long run commercial implications is relatively common. Strong sentiments against Government involvement in commercial R&D have been traditional in the United States. Cuts in development funding by the Reagan administration have re-emphasized the separation between R&D viewed as properly the responsibility of Government -- that dealing with public health and welfare, national defense, basic science -- and R&D directed at commercial products and processes. Foreign governments often draw the lines closer to the marketplace, but such lines necessarily exist in economies that follow a nominal free enterprise model.

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[5] Report of the White House Science Council Federal Laboratory Review Panel (Washington, DC: Office of Science and Technology Policy, May 1983). This report called for closer interactions between Federal laboratories and industry and the universities, although the recommendations for accomplishing this were rather vague (see pp. 11 and 12).

Federal Technology Diffusion Efforts

Transfer of results to the private sector, however, is part of the mission of Federal laboratories. Some of the many laboratories -- for instance, medical research facilities -- emphasize this more than others; HHS laboratories have extensive, long-standing ties with the medical and health care communities. The situation is quite different in the physical sciences and engineering, where private sector firms engaged in manufacturing, and some service-oriented companies, comprise the natural set of recepients for Federally generated technologies. Beyond aerospace firms and military contractors, interactions have seldom been close. Improvement is plainly possible, and could help American companies utilize technology to improve their competitive position.

The question of moving results from Federal laboratories to the private sector has been a longstanding concern of Congress and the executive branch. For many years, hearings and reports have pointed to the large proportion -- said to be 90 percent -- of Federally-owned patents that are never licensed or otherwise commercialized. However, such statistics are of questionable relevance because relatively few patents are ever commercialized regardless of ownership. Given that Federal R&D has seldom been pursued with commercial goals, the fraction should in any case be expected to be low. Furthermore, patents have declined in significance in many industries; drugs and pharaceuticals may be an exception, but substantial commercial advantages resulting from patent protection have become relatively rare in manufacturing. As a consequence, licensing of patents owned by the Government can be regarded as no more than a minor part of Federal technology transfer.

Although most Government R&D targets problems of limited relevance for civilian industries, exceptions do exists. Unfortunately, where stimulating commercial development has been a goal, Federal programs have often been less than successful. R&D objectives have not always matched the needs of potential users, typically because user communities and their needs have not been carefully identified. Government agencies have perhaps been too far from the marketplace. Fascination with technology has often seemed to drive projects forward regardless of needs and opportunities. The Department of Transportation's ill-fated people-mover programs, for which no need was ever demonstrated, provide a classic series of examples. Programs sponsored by DOT aimed at electric or hybrid cars can be criticized on the same basis, as can a number of NASA's efforts in energy R&D.

NASA has gone to greater lengths than other Federal agencies to publicize its technology utilization efforts. Although the agency's developments in remote sensing, and of course earth-orbiting satellites themselves, have had far-reaching impacts on the civilian economy, the NASA's efforts to transfer more mundane kinds of technology to industrial firms have met with limited success at best. Much of the information available through NASA's technology utilization programs has consisted of routine engineering results, often suited for narrow if not unique applications; some has been little more than gadgetry. The market for this sort of technology has proved modest.

The opposite is true of NASA's longstanding R&D in subsonic aerodynamics, which has evolved over the years in close conjunction with research programs in American universities and design practices as well as ongoing R&D in the civil aviation industry. The ties between NASA's laboratories and the community of engineers and scientists outside Government have been strengthened over many years of attacking common problems.[6] New knowledge has been generated; technology diffusion proceeds quickly and efficiently because people work together. NASA support for characterizing the mechanical properties of high-strength aluminum alloys has had similarly fruitful results.

Over the years, the National Science Foundation's experiences have also shed a good deal of light on successful technology development and diffusion, as well as on some of the pitfalls to be avoided. The RANN (Research Applied to

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[6] Aeronautical Research and Technology Policy, Volume 1: Summary Report (Washington, DC: Office of Science and Technology Policy, November 1982); J.L. Ethell, Fuel Economy in Aviation, NASA SP-462 (Washington, DC: National Aeronautics and Space Administration, 1983).

National Needs) initiative of the 1970s and its successors suffered from the common dilemma -- R&D too far removed from the marketplace, technology pursued for its own sake. In contrast, NSF's efforts, now more than a decade old, to develop on an experimental basis centers for cooperative research and for innovation carry important lessons for effective programs.[7] The major points hold few surprises. End-users of the technology, those who define the needs, must be close to the marketplace. Government employees can seldom fill this role. The developers of the technology -- in NSF's programs, typically university faculty and graduate students -- must have close working relationships with the end-users. Successful centers depend on aggressive leaders who are also well-known engineers or scientists. (Industry judges the prospects for a center, and decides whether to support it financially, largely on the basis of the people involved.)

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[7] Many NSF reports cover the agency's experiences with these centers. An excellent summary can be found in R.M. Colton and G.G. Udell, "Implications of the Stevenson-Wydler Technology Innovation Act of 1980, Public Law 96-480," Frontiers of Entrepreneurship Research 1983, J.A. Hornaday, J.A. Timmons, and K.H. Vesper, eds. (Wellesley, MA: Babson College, 1983), p. 422. At present, NSF sponsors eight cooperative research centers, plus nine innovation centers, with a number of others in the planning stages. In 1982, about $10 million went to the eight cooperative research centers, more than 80 percent contributed by a total of 110 industrial sponsors, the remainder by the Federal Government.

The paper cited above also includes a useful survey of the background and provisions of the Stevenson-Wydler Act, and its current status. In 1981, the House Subcommittee on Science, Research, and Technology held three days of hearings on the Act -- Implementation of P.L. 96-480, Stevenson-Wydler Technology Innovation Act of 1980, hearings, Subcommittee on Science, Research, and Technology of the Committee on Science and Technology, U.S. House of Representatives, July 14, 15, 16, 1981. Also see "The Stevenson-Wydler Technology Innovation Act of 1980: Report to the President and the Congress from the Secretary of Commerce," February 1984.

Prospects for cooperative research in the United States were extensively studied by the Department of Commerce during the Carter administration. See, for example, "Cooperative R&D Programs in Selected Federal Agencies," prepared for the Office of Science & Technology, U.S. Department of Commerce, September 1979.

Finally, it is worth noting that NSF, like other Federal agencies concerned with R&D, has experimented over the years with many programs that have been intended to link engineers and scientists in universities with those in industry besides cooperative research centers. For an overview of such linkages, see University-Industry Research Relationships: Myths, Realities and Potentials, Fourteenth Annual Report of the National Science Board (Washington, DC: National Science Foundation, October 1982) and The Federal Role In Fostering University-Industry Cooperation, GAO/PAD-83-22 (Washington, DC: General Accounting Office, May 25, 1983).

To reiterate the main point of this section: when Government is the end user of new technology, as is the case for military systems, Federal support for R&D is relatively straightforward. An extensive array of institutions and mechanisms exists for funding and carrying out activities ranging from pure science to the design, development, and manufacture of new weapons. The procedures may not be perfect, but they work. When the primary objective is commercial technology development, the Federal Government has far less experience to draw on -- much of it negative -- and a limited array of institutional mechanisms. Thus far, the Government's attempts to develop and diffuse commercial technologies should be regarded largely as experiments -- some successful, others not. Important lessons can be learned from the failures as well as the successes. A continuation of the experimental approach, in which mistakes are both permissable and inexpensive, is desirable.

TECHNOLOGY AND SCIENCE

Where do new commercial technologies come from? Sometimes from scientific research, but not always -- even in recent years. Whether big science or little, impacts on commercially significant products -- and the processes by which they are manufactured -- tend to be indirect, or long in coming, or both. Nuclear power, glycoproteins such as interferon, expert systems for artificial intelligence -- all are current or emerging commercial realities stemming from the basic research of earlier years. But far more often, research results are used in improving what already exists; to support research solely because it may lead to breakthrough innovations and entirely new classes of products or services would not only risk disappointment, it would misconstrue the nature of this activity.

The invention of the transistor depended on theoretical understanding of conduction in crystalline lattices developed during the 1930s, technology which followed the science by perhaps two decades. No one could know that the original research would be put to this use. Only during the 1960s did the design of electron devices become part of the practice of engineering. On the other hand, the microprocessor, as pointed out above, was the outcome of a pure exercise in engineering design; no new science was required. Today as well, the design of very large-scale integrated circuits proceeds at a rapid pace despite scanty theoretical foundations. Fabrication processes for microelectronic devices would be far easier to control if based on better process models, while productivity in software generation, currently quite low, might benefit from programming methods based on "scientific" understanding. Design itself -- the culmination of most engineering projects -- remains far closer to art or craft than science.

Because scientists seek knowledge while engineers solve problems, it should be no surprise that, historically, technical development has often preceded scientific understanding. The Wright brothers were highly creative engineers. Their work in aerodynamics and control systems depended more on experimentation than on analysis; at the time they flew their first airplane, the lift created by an airfoil could not be calculated, nor were the stability requirements for flight understood. Thirty-five years later, the development of xerography followed a roughly similar path. Digital computers -- one of the triumphs of 20th century technology -- provide another illustration of Edison's dictum that invention consists 99 percent in perspiration, 1 percent in inspiration. Practical computers did depend on theoretical insights -- notably the concept of the stored program -- but theory and practice, as so often, advanced more or less in parallel. As in pure science -- where sometimes theoreticians must wait for experimentalists to catch up, while at other times experimental results go unexplained for years or even decades -- technology may temporarily outstrip science, while elsewhere science will lead quite directly to new technology. The point is a simple one. Technology depends on science in complex fashion. Federal support for science does not guarantee useful technological outcomes.

A Simple Picture of the R&D Spectrum

Figure 1 gives a conventional view of the R&D spectrum, or "innovation pipeline." At one end comes basic research, at the other, the design, development, production, and marketing of some product or service: a new seed strain for growing corn, a line of 4-wheel drive tractors for cultivating it, a computer-controlled system for machining transmission components for those tractors.

Many kinds of activities go on at the right-hand end of Figure 1. A single technician experimenting with heat treatments to stop a claw hammer from chipping is engaged in development. So is a group of several hundred engineers and designers working on a turn-key polyethylene plant for Saudi Arabia. It is no surprise that the great majority of resources, in terms of people, time, and money, are expended at the right hand end of the spectrum.

The middle portion of Figure 1 is best viewed as a gray area of overlapping categories -- one reason DoD uses so many budget classes. More to the point, Figure 1 is oversimplified if taken to imply a predictable or linear progression from basic research to development to production.[8] In fact, research results may be necessary at almost any stage in development -- whether

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[8] The following quotation from the "Report of the Research Briefing Panel on Computers in Design and Manufacturing," Research Briefings 1983 (Washington, DC: National Academy Press, 1983), p. 63, makes the point:

"The central issue in the field of computers in design and manufacturing is a pervasive lack of scientific knowledge. This lack of knowledge is less pervasive than it was 10 years ago, in part because university research has been able to make some significant accomplishments with very limited resources. However, major gaps still exist, as this report illustrates. The first priority in this field is to build a genuine, classical research community. The large integration efforts identified in this report will require a much stronger base of fundamental knowledge than is now available."

During the 18th and 19th centuries, of course, mechanized production developed quite independently of science.

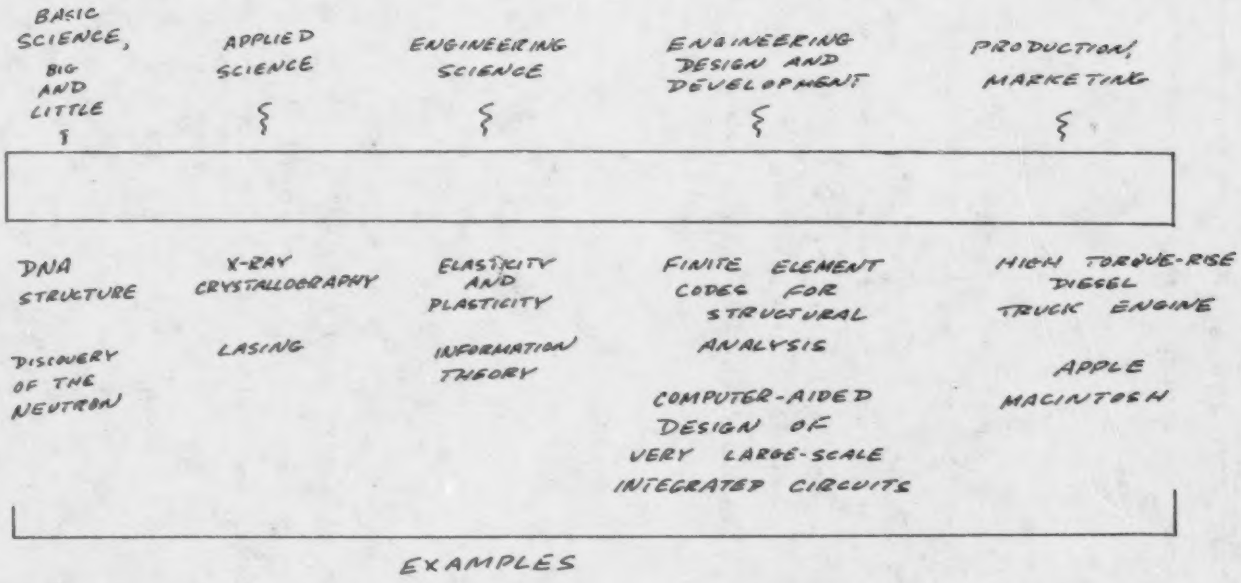
BASIC SCIENCE, BIG AND LITTLE
APPLIED SCIENCE
ENGINEERING SCIENCE
ENGINEERING DESIGN AND DEVELOPMENT
PRODUCTION, MARKETING
DNA STRUCTURE
DISCOVERY OF THE NEUTRON
X-RAY CRYSTALLOGRAPHY
LASING
ELASTICITY AND PLASTICITY
INFORMATION THEORY
FINITE ELEMENT CODES FOR STRUCTURAL ANALYSIS
COMPUTER-AIDED DESIGN OF VERY LARGE-SCALE INTEGRATED CIRCUITS
HIGH TORQUE-RISE DIESEL TRUCK ENGINE
APPLE MACINTOSH
EXAMPLES

Figure 1. Simplified Version of the R&D Spectrum.

the goal is an all-new product or process (actually quite rare) or the refinement of existing products and processes to take advantage of new knowledge originating elsewhere in the spectrum.

A More Realistic Picture of R&D: Structural Integrity of Aircraft

To illustrate the feedback and feedforward loops linking basic research with design and development, this section outlines the evolution of design methods for ensuring the structural integrity of aircraft -- a case where military and commercial R&D have been closely related. Simply put, the requirement is that critical elements of the structure -- wings, control surfaces, cabin, landing gear -- remain intact throughout the airplane's design lifetime. This is a complex problem, demanding tradeoffs between strength and weight. Because an airplane cannot fly if too heavy, margins of safety are low compared to bridges or buildings, even automobiles. And, needless to say, the consequences of structural failure can be disastrous.

In the early years of iron and steel construction, failures in structures such as bridges were attributed vaguely to acts of God, or gradual "crystallization" and "embrittlement" of metals in service. The crystallization explanation became untenable when x-ray crystallography -- a basic research tool -- revealed that all metals were inherently crystalline. Other pieces of knowledge came from different fields of science. Griffith's elegant studies of fracture in glass during the 1920s depended on earlier work in applied mathematics. Continuing progress in theory of elasticity and plasticity during the period between the wars helped lay the foundations for the field now known as structural integrity technology.

During the Second World War, knowledge accumulated rapidly, driven by the need to solve failure problems in ships as well as aircraft. Two paths were pursued: (1) experimental studies aimed at test procedures for ranking or qualifying materials, as well as providing design guidelines; and (2) theoretical analyses of the behavior of cracks in metals. Testing continued to be the principal means of ensuring the integrity of new designs. Prototype aircraft were subjected to extensive full-scale test programs -- time consuming and expensive.

By the 1960s, research in materials science and solid state physics allowed microscopic cracks -- long since known to cause fracture -- to be mathematically modeled. Digital computers were put to work analyzing crack extension processes. Design procedures gradually developed which permitted simulation of crack growth, hence predictions under service conditions. By the 1970s, the Air Force was ready to promulgate a military standard covering such analyses. Today, civil aircraft designs follow similar procedures. Testing continues, but prototypes are closer to being right the first time. Not only is structural failure less probable, but testing costs less.

Starting around 1920, then, and at an increasing pace since 1950, theory and application have interacted in complex fashion; the first graduate level textbook covering the new methods appeared in 1967. Only today is this technology diffusing into undergraduate engineering curricula. Aerospace is a research-intensive, high-technology industry; diffusion of structural integrity technology to other manufacturing sectors will continue over many years. Figure 2 illustrates some of the major contributions -- a marked contrast to the simple linear progression implied earlier by Figure 1.

A Discipline-Oriented Example: Materials Science

Materials science, as an identifiable discipline straddling one of the boundaries between engineering and science, illustrates the interactions between the two in yet another way. Materials scientists, as noted above, have made many contributions to the understanding of failure processes in metals; numerous other examples in which knowledge of material behavior has helped reinvigorate existing technologies could be cited.

In essence, materials science -- a field which stemmed from recognition of common themes in a broad variety of technical problems -- links the traditional study of metallurgy with the physics and chemistry of solids. The result is to place methods for solving problems ranging from cracking in metals to the design of electron devices on a more rigorous footing. Other examples include:

- corrosion (e.g., rust), an age-old problem with great economic costs;
- wear, even more widespread and costly than corrosion (the difference between a new 10-ton truck and a "worn-out" truck is a matter of perhaps 10 pounds);
- design of both metallic and nonmetallic materials (the storied properties of Damascus steel have finally begun to yield their secrets,

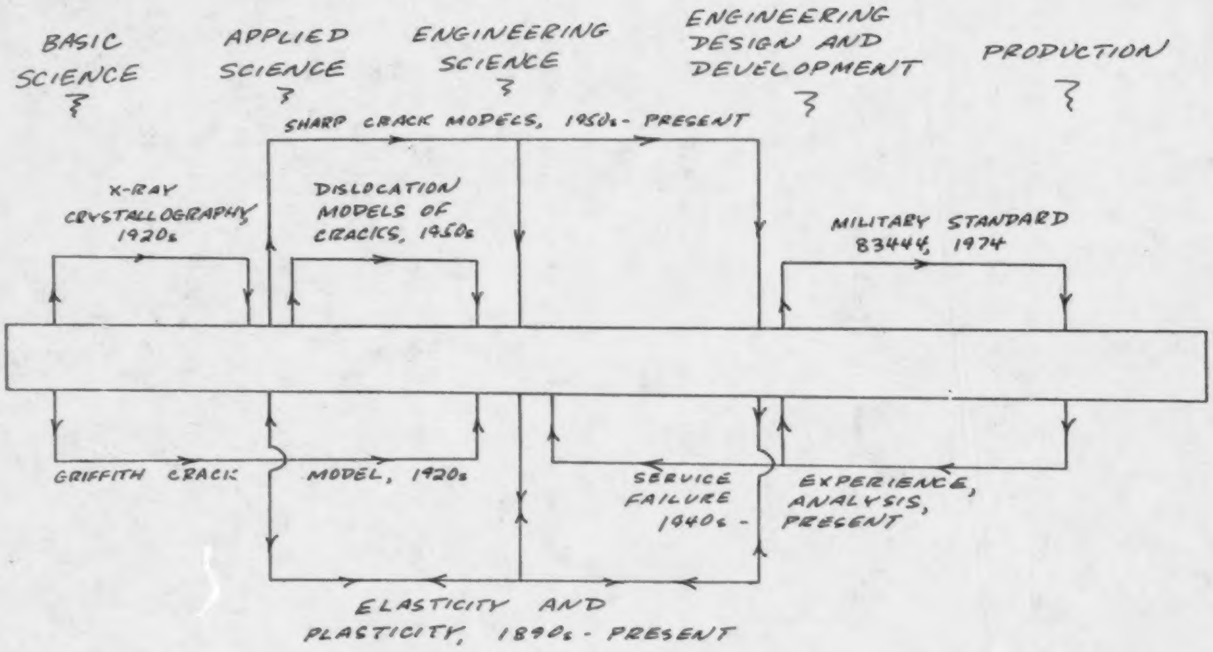
BASIC SCIENCE
APPLIED SCIENCE
ENGINEERING SCIENCE
ENGINEERING DESIGN AND DEVELOPMENT
PRODUCTION
SHARP CRACK MODELS, 1950s - PRESENT
X-RAY CRYSTALLOGRAPHY 1920s
DISLOCATION MODELS OF CRACKS, 1950s
MILITARY STANDARD 83444, 1974
GRIFFITH CRACK MODEL, 1920s
SERVICE FAILURE 1940s -
EXPERIENCE, ANALYSIS, PRESENT
ELASTICITY AND PLASTICITY, 1890s - PRESENT

Figure 2. Contributions to Structural Integrity Technology.

while the synthetic aramid fiber Kevlar resulted from an extensive targeted R&D effort);

- practical applications of superconductivity (e.g., in very powerful magnets);
- non-destructive inspection (welded steel ships, pipelines, and pressure vessels for power generation, not to mention rocket motors, would be far less practical without techniques for detecting flaws in welds).

Typically, old and new approaches to such problems coexist for years as technologies diffuse -- carried, as they always are, by people. One manufacturer of, say, extrusion dies will continue to rely on high-alloy steels for wear resistance, while another will be experimenting with ion implantation or chemical vapor deposition, attempting to decrease wear rates while replacing expensive but familiar alloy steels with a carbon grade. Ion implantation, in particular, remains an exotic "high-technology" technique. Suppose a smaller company, with limited technical resources, wishes to consider ion implantation for its products. Where does it go for help? (The new method will have drawbacks as well as advantages.) The case is typical. One answer is to look to new institutional mechanisms, supported by the Federal Government, for technology development and/or diffusion.

POLICY IMPLICATIONS

As OTA has pointed out in several reports on the international standing of American industries, sometimes technology is vital for competitive success, sometimes secondary. But in virtually all industries, the technological advantages of American firms have been shrinking for years; even where U.S. technology remains superior, foreign rivals may, later if not sooner, close the gap.

U.S. technology two decades ago was unmatched elsewhere in the world; in international markets, American firms could take advantage of superior technology through direct investments as well as exporting; the Nation imported few manufactured goods. Today, these technological margins have diminished or vanished. In some cases, U.S. firms remain ahead (microcomputers); elsewhere, rough parity exists (integrated circuit memory chips). Where American manufacturers have fallen behind, it may take a decade and more, under the best of circumstances, to catch up -- for example, in designing and producing small cars. Now and in the future, U.S. industry will find itself competing in a new environment. Should the U.S. Government, therefore, redirect its technology and science policies?

In fact, although the United States has supported research in the physical sciences consistently if not always munificently since the beginnings of the nuclear era, no such pattern can be found for technology. The Department of Defense pays for work that will add to the Nation's military stength. Most of NASA's R&D goes toward its own missions -- manned space flights, technology that will support space science. Note that NASA's projects, ambitious as they are, do not always break new technical ground. The agency's greatest achievements lie in systems integration. Very high costs of failure lead to conservative design practices; space is no place to test new ideas unless there is, quite literally, no option. If the United States proceeds with a space station program, the technological fallout will have no more than scattered and indirect impacts on most of American industry, just as for the Apollo program or the shuttle. Indirect impacts can be powerful -- certainly this was the case with Apollo -- while doing little to solve the day-to-day competitive problems of U.S. industry. Moreover, while the scaling back of energy R&D must eventually reverse, for now the United States continues to move away from energy R&D. Federal agencies support R&D in the physical sciences and engineering in pursuit of their own missions; industrial technology has no home within the Federal Government.

Leaving aside NSF support for basic science, the mission-orientation of Federal R&D is pervasive. While the $4 1/2 billion budget of the National Institutes of Health pays for work ranging from basic studies in the biological sciences to epidemiology to studies of the health care delivery system, the goals, short or long run, are the same: to improve health and the quality of medical care. NIH support has laid the foundations for the emerging biotechnology industry, but that was not its purpose. DoD sponsorship of university research, as well as R&D in industry, likewise can be traced under virtually all circumstances to relatively well-defined military problems. Leaving aside the Department of Energy's sponsorship of "big science" projects in nuclear physics, much the same is true for other Federal agencies. The relatively small programs of the National Bureau of Standards stem from that agency's measurement and standards responsibilities. NBS studies electron devices because of the need to measure very small feature sizes. Concern for interface standards and programming languages lies behind much of the Bureau's work on computer systems and automated manufacturing.

Nor has industrial technology -- largely a matter of engineering -- found a home within the National Science Foundation, the focal point within Government for untargeted, fundamental research. More than 90 percent of NSF's budget goes to support basic research, almost all in universities. Historically, about 10 percent has supported engineering research (in fiscal year 1984, $126 million out of $1.2 billion). This money has been spread among several thousand departments in the Nation's engineering schools -- which number nearly 300. For a decade, these schools have been starved for resources. Undergraduate enrollments have increased steadily. Neither staffs nor facilities have kept up. Research equipment and laboratories have grown increasingly obsolete.[9] While several reorganizations over the past few years have given engineering greater prominence within NSF, the Foundation's priorities are unlikely to shift very much unless change is forced from the outside. This is a science agency and plainly will continue to be. Scientists make their contributions to innovation and competitiveness, as do specialists in marketing, industrial design, and other disciplines. But the engineering profession carries most of the responsibility. As a consequence, proposals for a National Technology Foundation or National Engineering Foundation have become more frequent -- e.g.,

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[9] The situation of U.S. engineering schools is described in detail in International Competitiveness in Electronics (Washington, DC: Office of Technology Assessment, November 1983), pp. 305-311.

H.R. 4245, the National Professions and Technology Foundation Act of 1983, introduced in October 1983.

Creating a National Technology Foundation is only one of the possible ways to create a home within the Federal Government for engineering and commercial technology. Motivated in part by the slide in competitive standing of a number of prominent U.S. industries, dozens of bills have been introduced in Congress over the past several years aimed at one or more of the following: increasing Federal priorities for technology and engineering; encouraging innovation; supporting commercial technology development and diffusion; steering more resources toward engineering education.

The Stevenson-Wydler Act, passed in 1980 and mentioned at several points above, dealt with many of the major issues. The approach, essentially structural, contrasts with the Small Business Innovation Development Act (P.L. 97-219), which became law in 1982. Stevenson-Wydler provides for a network of industrial technology centers, a National Industrial Technology Board, and new initiatives for transferring technologies from National laboratories to the private sector -- even a National Technology Medal (not yet awarded). The Small Business Innovation Development Act, on the other hand, simply reserves a fraction of the R&D budgets of all Federal agencies for smaller enterprises, on the grounds that they are more efficient innovators. Both bills could, in principle, have considerable impact. For practical purposes, however, Stevenson-Wydler has never been implemented, while most Federal agencies have been slow in complying with the provisions of the Small Business Innovation

Development Act.

Even so, given that this pair of laws are in place, should more be done? In fact, proposals continue to be made, bills to be introduced. And there are good reasons for moving beyond these two pieces of legislation. First, the Stevenson-Wydler Act does not establish a new agency -- rather it gives new responsibilities to existing agencies. As noted, these agencies have been slow in accepting them. Second, the Act authorizes Centers for Industrial Technology to be established under the aegis of the Department of Commerce -- these centers to eventually become self-supporting. OTA's analysis indicates that continuing Federal funding is necessary if the centers are to engage in R&D with longer time horizons than those of private industry. Finally, the Small Business Innovation Development Act is intended as a general stimulus for private sector innovation: it does not seek to support particular technologies, much less diffusion.

The remainder of this section, therefore, discusses three possible policy initiatives: an Advanced Technology Foundation as called for in H.R. 4361; a National Technology (or Engineering) Foundation; and a civilian analog to the Defense Advanced Research Projects Agency, intended to sponsor commercially-oriented R&D with potentially high paybacks over the longer term. These three alternatives should not be viewed as exclusive of one another; under some circumstances, they might prove complementary. While hardly exhausting the possibilities, they do cover most of the major themes; the principal exception is engineering education, an important issue but one that OTA does not address in this Memorandum.

H.R. 4361, the Advanced Technology Foundation Act

OTA has been asked to comment specifically on this bill, introduced in November 1983. H.R. 4361 would establish an independent agency, the Advanced Technology Foundation, which would seek to facilitate technology diffusion and "the movement of basic scientific research into products or processes" [Sec. 2(b)]. The ATF envisioned in this bill would differ from a National Technology Foundation because engineering research would remain within NSF; indeed, in its present form, H.R. 4361 does not provide for transfer of any existing agency functions to the Advanced Technology Foundation.

The ATF would differ from a civilian DARPA in focusing on generic technology development and diffusion, while not attempting to identify and support future commercial technologies per se; thus H.R. 4361 seeks to fill many of the gaps in R&D which OTA points to in the sections above. OTA has found in its studies of industrial competitiveness that generic technology development and technology diffusion to U.S. firms are primary needs for strengthening the international position of American industry. While H.R. 4361 would be a positive step in its present form, it could be strengthened as outlined below.

Section 6 of H.R. 4361 covers ATF activities in support of technology development; Sec. 7 authorizes a Federal Industrial Extension Service for technology diffusion. The bill provides for grant funding of research on generic technologies, for contract funding of joint R&D involving universities and industry, and for loans for commercial technology development [Sec. 6]. OTA has two major suggestions with respect to *generic technologies*. *First, the bill* might provide specifically for a network of technology centers, to be associated with universities though not necessarily located on university campuses. These centers would have as their primary responsibility generic technology development. The bill might set aside, say, $50 million in the Foundation's first annual budget for establishing 20 such centers. Identifying the first group of centers could be a responsibility of the Board of Directors [Sec. 4], a task which might be shared with the Council for Industrial Competitiveness envisioned in a companion bill, H.R. 4360, the Industrial Competitiveness Act. OTA suggests that at least five of the initial centers be established on an industry basis (e.g., automotive technology), the remainder on a technology basis (e.g., engineering design). Language in the bill calling specifically for an experimental attitude toward the initial centers might serve to encourage enlightened risk-taking by the Foundation.

OTA also suggests that Sec. 6(1), Subsection (b) be altered to permit funding of joint industry-university R&D on a grant basis, as well as a contract basis, provided the R&D is carried out on a university campus or within a generic technology center (but not in an industrial laboratory). In general, grant funding is more appropriate for R&D which is closer to basic research. Permitting the grant mechanism for joint R&D would bring an industry viewpoint to some of the basic research supported by the ATF.

Before turning from R&D to diffusion, the question remains whether it might be better to move engineering research to the new Foundation, rather than leaving it with NSF. Giving this responsibility to the ATF has a major advantage: linking applied and commercially-oriented R&D more closely to basic engineering research. Generic technology development, for instance, will often depend on fundamental studies in the engineering sciences. The risk here is the same as for a National Technology Foundation -- cutting engineering off from its roots in the sciences. As indicated later, this risk seems small. Given the broad charter in H.R. 4361 for an ATF to support commercial technologies, it seems appropriate to integrate engineering research into this spectrum of activities.

Turning now to the Federal Industrial Extension Service [Sec. 7], OTA notes that this might function better if the generic technology centers discussed above were given an explicit role in extension and diffusion activities. This might be done by providing for an extension office in each center, with these offices funded independently of centers' R&D budget. Giving the centers this responsibility should, however, be viewed as a supplement, not a replacement, for other extension activities.

Coordination of State industrial extension programs [Sec. 7(b), Subsection (1)] might be facilitated by appropriating funds to each State for partial support of its own programs. Budgeting could be on a formula basis, taking into account such factors as Statewide employment in manufacturing. Alternatively, the Federal Government might simply match some percentage of funds appropriated by States for technology extension programs.

OTA also suggests that a sixth subsection be added to Sec. 7(b). The purpose would be to establish within the Federal Industrial Extension Service an Office of Foreign Technology. This Office would be charged with acquiring and disseminating information and analysis dealing with science and technology from foreign countries, particularly Japan and the Soviet Union -- another task that might be shared and coordinated with the Council for Industrial Competitiveness which H.R. 4360 would authorize. Ultimately, technologies are diffused by people; translations and literature searches are not enough. An Office of Foreign Technology would have greater impact if staffed by competent technologists with resources adequate for overseas travel. Employees of the Office could be stationed in other countries without duplicating the work of the science attaches at U.S. embassies. Liaison offices operated by the Office of Naval Research and other military agencies provide a useful model.

Finally, because the Stevenson-Wydler Act already authorizes several of the functions that H.R. 4361 would give to the Advanced Technology Foundation, it might be desirable to include language providing for transfers of these responsibilities to the ATF.

A National Technology Foundation

Whether called an NTF or a National Engineering Foundation, whether narrowly focused on research in engineering or dealing with a broad range of concerns (as does H.R. 4245), the intent of this option is straightforward: to give R&D concerned with technology (rather than science), particularly basic engineering research, greater priority at the Federal level. This would be accomplished by moving support for engineering from the National Science Foundation to an independent agency; some proposals for an NTF would also transfer the National Bureau of Standards, now under the Commerce Department. H.R. 4245 would go still further, shifting into the new Foundation the Patent and Trademark Office, the National Technical Information Service -- both now in Commerce -- along with most of the responsibilities given the Department under the Stevenson-Wydler Act. But central to all proposals for an NTF is the removal of primary responsibility for engineering and technology from NSF. This should be the starting point for evaluating such proposals.

Most of NSF's funding goes toward basic research. It is basic engineering work that would move from NSF to an NTF. Thus the question: How different is basic research in engineering from basic research in science? Supporting engineering research may be no more than a minor part of NSF's mandate -- taking only 10 percent of the budget -- but if the inter-relationships between engineering and science are close, separating the two may do more harm than good.

Modern engineering and technology rest on a base of scientific knowledge. Even for the routine practice of engineering, this has been generally true since the turn of the century. During the post-World War II period, the profession has moved steadily toward an "engineering science" orientation. Engineering science -- emphasizing mathematical tools and rigorous analysis -- finds foundations not only in the physical sciences but in applied mathematics. Over the past 15 years especially, inexpensive computing power has given the engineer new tools for both design and analysis. Today, particularly at the frontiers of research, the boundaries between engineering and science are far from sharp. Earlier examples -- e.g., Figure 2 -- demonstrate the closeness of the relationship, as does the existence of hybrid fields such as materials science. At the same time, there is a continuing need to bring several of the practice-oriented branches of engineering -- notably manufacturing -- closer to the engineering science model.

Does this mean that removing engineering research from NSF and giving it to a National Technology Foundation would prove counterproductive? While the divorce could, in fact, have negative consequences, positive outcomes seem more likely. First and foremost is the simple matter of resources. Even under the best of circumstances, it is hard to envision that the National Science Foundation as it is presently constituted would increase funding for engineering research to more than, say, 15 percent of its total research budget. Engineering research agendas in universities have been skewed toward military problems as faculty, faced with relatively low levels of support from NSF, have turned to DoD for funding. An independent NTF could prove a powerful lever for moving university research toward topics more suited to civilian needs.

The NTF alternative does run some risk of loosening the ties between engineering and science, and of encouraging R&D that is less than rigorous by scientific standards. However, such risks appear small. Engineering has depended on science -- and science on engineering -- for a century. Rearranging institutional responsibilities within the Government will not change attitudes and behavior patterns within a well-established profession like engineering to any great extent. Some engineers working in specialties close to scientific fields will continue to get support from NSF. Some applied physicists or polymer chemists would no doubt find it natural to submit proposals to a Technology Foundation. Furthermore, reorienting teaching and research in engineering towards practical problems in design and manufacturing -- bringing these two critical engineering functions back into the mainstream, particularly at universities -- would be easier given an NTF emphasizing industrial technologies and charged with helping maintain the competitiveness of the U.S. manufacturing base.

The argument for removing responsibility for engineering research from the National Science Foundation and assigning it to an independent agency with a mission emphasizing technology is a strong one. On the other hand, a substantial shift in NSF's orientation -- for example, modifying its structure so that it became a National Science and Engineering Foundation, with engineering having equal standing -- would also be a positive step, provided engineering was guaranteed adequate funding.

A Civilian DARPA

While proposals for a National Technology Foundation seek first of all to raise priorities for engineering research in universities, most of the suggestions for a civilian agency paralleling the Defense Advanced Research Projects Agency envision direct support for commercially-oriented R&D -- perhaps dramatic ventures into advanced computers and information systems, automated manufacturing, biomedical engineering. Such an agency would inevitably move the Federal Government closer to the marketplace.

How would a civilian DARPA set priorities, pick and chose its R&D targets? OTA has discussed such questions at length elsewhere.[10] In essence, mission-oriented technology development requires choices of a sort which basic research and generic technology development can avoid; the latter find application in many industries and to many problems, minimizing the difficulties of selecting projects and targeting R&D expenditures.

If a civilian DARPA took over support for basic engineering research from NSF, thus emphasizing work with long-term paybacks in the civilian economy, this could prove a more workable alternative. Such an agency might differ from NTF proposals in several ways. First, it might allocate a greater fraction of its budget to R&D conducted by industry as opposed to universities. Second, it might increase priorities for advanced development, plus technology demonstration. Third, it might seek to stimulate innovation and build support for competitiveness as a goal of national policy by searching for technical breakthroughs that would spark public interest.

But how would a civilian version of DARPA define its mission? While the

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[10] Although the context differs somewhat, see International Competitiveness in Electronics, op. cit., pp. 475-482.

Defense Advanced Research Projects Agency has served the military well, defense-related technologies, though covering a broad spectrum, remain specialized compared to the full range of technologies applicable in civilian industries. The military knows its mission; DARPA has a well-defined place in this. Parallels between DARPA and civilian technology development are relatively few. If a civilian DARPA concentrated on basic research in engineering, it would become much like an NTF. If it emphasized technology diffusion, it would move relatively far from the DARPA model.

Developers of commercial technology must be close to the marketplace -- for DARPA, the rest of DoD. Federal experiences with synthetic fuels, solar energy, and the breeder reactor illustrate the pitfalls of Government projects when Government is not the customer. Support for commercial technology development can be managed successfully, as shown by NASA's subsonic aerodynamics R&D or NIH funding for medical technologies. Nonetheless, the Federal Government does not have a great deal of applicable experience when it comes to industry in general. While DARPA holds useful lessons for civilian technology development, a Federal agency for developing advanced commercial technologies would run severe risks of misjudging market needs and opportunities.

APPENDIX

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January 12, 1984

Dr. John H. Gibbons, Director
Office of Technology Assessment
U.S. Congress
Washington, DC 20510

Dear Dr. Gibbons:

I expect that the Committee on Banking, Finance and Urban Affairs will take up H.R. 4360, the Industrial Competitiveness Act, and H.R. 4361, the Advanced Technology Foundation Act, early next year. OTA's Staff Memorandum "R&D in the United States and the Other OECD Countries" proved most useful in the preparation of these bills.

At our Subcommittee's hearings on November 14, you will recall that I invited your comments on our industrial policy legislation. In particular, we would like OTA to prepare another paper for the use of the Subcommittee, this one focusing more narrowly on the need for an Advanced Technology Foundation or some similar institution.

Specifically, I ask that OTA address the following questions:

1. What differences in mission would distinguish the ATF, or some alternative institutional mechanism, from existing Federal agencies such as the National Science Foundation, the Defense Advanced Research Projects Agency, the National Bureau of Standards, and the many national laboratories?

2. Does the United States need a Federal agency charged with stimulating and supporting the development of new commercial technologies themselves, better mechanisms for diffusing technologies to American industry, or both?

Dr. John H. Gibbons
Page 2

3. What forms other than the ATF as outlined in H.R. 4360 and H.R. 4361 might the Federal Government consider as alternatives for improving the environment for development and diffusion of commercial technologies -- both product and process -- in the United States?

We would appreciate a draft of this paper by January 31, 1984.

Sincerely,

John J. LaFalce

JOHN J. LaFALCE
Chairman

Action ITE-Alic
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Congress of the United States
OFFICE OF TECHNOLOGY ASSESSMENT
WASHINGTON, D.C. 20510

JOHN H. GIBBONS
DIRECTOR

JAN 30 1984

The Honorable John J. LaFalce
Chairman
Subcommittee on Economic Stabilization
Committee on Banking, Finance, and
  Urban Affairs
U.S. House of Representatives
Washington, D. C. 20510

Dear Mr. Chairman:

Thank you for your letter of January 12 asking that OTA prepare a brief Staff Memorandum discussing the need for an Advanced Technology Foundation or some similar institution.

While we would not be able to respond by January 31, we should be able to provide a draft for the Subcommittee's use by February 29, 1984, with a final version one week later. John Alic, of OTA's Industry, Technology, and Employment Program, has discussed this timing with Mary Ann O'Connor of the Subcommittee staff. As Ms. O'Connor indicated that such a schedule would meet the Subcommittee's needs, we will proceed on that basis unless we hear from you otherwise.

Sincerely,

John H. Gibbons

J.Alic:ITE:ja:1/26/84

cc: Director (2)
  AD's
  Director, CRPA
  Admin Officer
  ITE

Dr. ALIC. Now turning specifically to Japanese technical information, the first problem, of course, is the language barrier, a pervasive problem. Let me emphasize, first of all, that the situation is not perhaps as bad as it might seem.

Japanese engineers and scientists routinely publish some of their work in English, not only in international technical journals but in journals printed in the English language in Japan. Indeed, 60 percent of the volumes in Tokyo University's engineering library are written in Western languages.

There is, at the same time, a great deal of Japanese language technical literature which is difficult for Americans to acquire because few American scientists and engineers speak or read Japanese.

But if, as I said earlier, technologies are transferred and used by people, is the technical literature really that important? In fact, it is, because before you can begin to use technology you have to do your homework. You have to dig through the books, the journal articles, the conference volumes, Government reports, the trade press, to discover what is known, to find problems, find the people working at the forefront of the state of the art. Print media has been, and will remain, indispensable for that.

There is a vast and rapidly growing volume of technical literature in English, and in Japanese. This has been a problem, I think, for all working scientists and engineers in the last decade.

The point I would stress concerning that vast volume of technical literature is its redundancy. Working scientists and engineers tend to publish a good deal on the subjects that form the core of their own work. They need that redundancy to get their point across to their own peers. So it's not necessary to have access to 100 percent of the information that a given researcher has published. One can get a good sense from a much smaller sample.

The problem in terms of foreign languages and Japanese then, is one of discrimination, in determining which items of the vast pool of technical literature are important. To discriminate good from bad, or to operate with a set of decision rules based on quality and on the cost of continuing a search, takes technical judgment, it takes trained technical people. Once again, we run up against the fundamental problem, which is that few trained technical people speak or read Japanese; many more can handle Russian, even.

There are ways to deal with that problem. At OTA we have formed multidisciplinary groups involving people competent in the Japanese language with scientists and engineers as our way of dealing with this problem.

First, it's not possible to translate everything; it's too expensive, if it's done by people. It's technically well in the future if we think about computerized translations.

There are some second best alternatives where one can get a good sense of the quality of technical literature: abstracts, looking at quantitative information, charts and graphs, equations, results; all these can be useful.

One of the suggestions that we would have is that a Federal agency, perhaps the Department of Defense, sponsor a high quality series of abstract and review journals in which technical experts here in the United States would select Japanese publications based on the many clues that engineers and scientists use in evaluating research quality. There are precedents for that, of course, in review journals in Western languages.

There are other things that the Federal Government could do as well. It might be appropriate to expand the work of the National Technical Information Service, which might review and abstract government publications from Japan in a similar way.

I think it's also important for the Federal Government to continue its efforts to help U.S. companies gain access to Japanese patents.

Let me list four more things that the Federal Government might consider.

First of all, the Government might add more technically trained people to the staff of the Tokyo Embassy and to consular offices in Japan with responsibility for critically analyzing and evaluating Japanese technology. There's much more that can be done beyond the needs of the military and intelligence communities.

Second, the Government could provide financial support not only for libraries with extensive Japanese language collections but for the great majority of the engineering and science libraries in American universities which today cannot even keep up with the technical literature in English, because the costs are outstripping their resources.

Third, the Federal Government might offer financial aid to college level students in technical fields who wish to learn Japanese as well as to specialists in Japanese studies who wish to collaborate with technologists or to study economic and industrial questions dealing with Japan.

Fourth, the Government could support, through the National Science Foundation and other agencies, international travel as well as technical exchange programs for American engineers and scientists. United States representation at major international technical meetings has fallen to shamefully low levels.

Last, and perhaps most important, the Federal Government could proceed with the establishment of a network of centers for the development and diffusion of commercially oriented technologies—something the United States badly needs to strengthen its international competitiveness; and include the acquisition and transfer to U.S. firms of foreign technologies and the missions of at least some of these centers.

I stress this last point because such technology centers, as envisioned in the Stevenson-Wydler Act, Public Law 96-480, and discussed at length in the forthcoming OTA staff memorandum that I mentioned earlier, would provide an institutional setting for American engineers and scientists to work actively with and learn from Japanese technology. That should be the ultimate goal.

Thank you. That concludes my remarks.

[The prepared statement of Dr. Alic follows:]

STATEMENT OF
JOHN A. ALIC
PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT
BEFORE THE
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
COMMITEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

MARCH 7, 1984

Mr. Chairman and members of the Subcommittee, thank you for inviting OTA to testify on the availability of information on Japanese technology and science, and its importance for the United States. With me is Martha Caldwell Harris, who participated in the assessments which provide the foundation for this statement.

My comments today are based on several OTA studies of industrial competitiveness, work that goes back more than five years and covers sectors including steel and automobiles. Last November we published a report on

International Competitiveness in Electronics which contained a careful look at Japan's capabilities in electronics, while also examining industries in Western Europe and several of the newly industrializing countries.

In that report, OTA compared the U.S. industry -- particularly computers, semiconductors, and consumer electronics -- to foreign industries over a range of factors from technological strength and manufacturing practices to business strategies, financing choices, and management styles. OTA analyzed national industrial policies in Japan and other countries, concluding with an outline of possible courses of action should the United States decide to pursue a more focused industrial policy of its own.

Much of OTA's work has entailed U.S.-Japan comparisons. These demonstrate quite clearly that the United States can learn from Japan's technology and science, but that this will not be easy. Despite all the publicity given to Japan's economic miracle, even to whole books on the fifth-generation computer project, too many Americans still look for simple explanations of Japan's successes. Cheap labor. Cheap capital. Government subsidies and favorable exchange rates. Labor-management cooperation. Copying and commercializing American innovations. In technology, however, shortcuts are few. Developing successful commercial products -- like winning Nobel prizes -- takes hard work and commitment.

JAPANESE TECHNOLOGY

The Japanese are, first of all, excellent technologists, highly creative and getting better fast. In manufacturing industries, their success has been built, not only on aggressive marketing, but on highly refined engineering design and careful attention to production processes.

Much can be learned by visiting Japan, by studying the technical and trade literature, by talking with Japanese engineers and scientists -- methods OTA has used in its assessments. But the primary evidence of how good Japan's engineering has become fills our homes and highways. Nonetheless, the myths -- that Japan copies Western technology, that the Japanese cannot innovate, that their edge is "quality" in some narrow, statistical sense -- still seem to persist. Indeed, it has always seemed to me a sign of how widespread technological illiteracy has become within the United States that Japanese management can be in vogue while the excellence of Japanese engineering goes unrecognized.

Modern technology holds few secrets. But a great many lessons in using technology can only be learned through experience. Hence my second point: people develop technology, and people transfer technology. Books, technical papers, computer programs, conferences, visits to factories and laboratories -- all these help, but are seldom more than starting points. To learn very much from Japanese technology, you have to use it for something. General Motors, which spends more on R&D than any other American company, negotiated its proposed joint venture with Toyota in part to gain access to the latter's know-how. GM wants its engineers and managers to work alongside those from Toyota. Looking at the specifications for an automobile gives some insight into design decisions. Taking a car apart gives more. Talking and working with the people who made those decisions is still better. The same is true for laying out a factory, designing production lines and tooling.

Over the past half-dozen years, American companies have learned from Japan's technology at an accelerating pace -- a heartening sign. If the United States can learn from other countries as they have learned from us, there is no reason why American industries cannot continue to compete effectively in world markets. After all, the period during which the United States was far ahead of the rest of the world in its technology lasted little more than two decades. Through the 1930s, American companies imported a good deal of technology. Even in the earlier postwar period, when the United States was well ahead in most technologies, our missile and space programs got a big boost from German expertise.

My third point is this: although private companies will be the primary users of Japanese technology, the Federal Government can and should help make information and analysis dealing with Japan's technology and science available here. The language barrier is only one reason. Later in this statement, I suggest several ways the Government could do so.

Manufacturing in Japan and the United States

Recognition by U.S. firms of Japanese manufacturing skills came earlier than full appreciation of Japan's product technologies. During the 1960s, American firms were still transferring steelmaking technology to Japan. In the middle 1970s, Japanese steelmakers were hit hard by rising energy costs. They made rapid strides in process control -- fine-tuning the production process to minimize energy consumption. This improves quality, as well as saving money directly. After the "energy shock" of the 1970s, American steel companies began purchasing Japanese technology. In such transfers, technical personnel on both sides may work closely together for several years.

Process control is even more vital when manufacturing integrated circuits. Information on yields -- the fraction of "good" circuits coming off the production line -- is closely guarded. Still, we hear repeated reports of higher yields for otherwise similar products in Japan. When, in 1982, Texas Instruments shifted its 64K RAM production to Japan, yields and quality control were among the reasons.

In the automobile industry, Japanese engineers reportedly have learned to use CVD (chemical vapor deposition) coatings to increase the life of blanking and forming dies by factors of 100 to 1000. Reading the technical literature on such processes is only a first step toward getting results comparable to Honda's; that takes experience with the technology. But especially at the research level, relatively few Americans work on such seemingly mundane problems.

Indeed, manufacturing engineering remains a decidedly unglamorous field in the United States. The waves of publicity concerning robots and other forms of computer-aided automation have not changed things much. The best graduates of our business and engineering schools avoid the factory floor. Unfortunately, that is where many of the major technical problems arise. Process control for making integrated circuits is more art than science. Why? Because mathematical models of the physical and chemical phenomena remain quite crude. Much the same is true for steelmaking. In the emerging biotechnology industry, scale-up toward commercially viable production volumes, heavily dependent on modeling and control, will be critical for competitive success. Analyzing manufacturing processes -- necessary for controling them -- is a classic problem in the engineering sciences, but one that has received little attention in this country. Here is one lesson we can learn from the Japanese, as well as the Germans: process engineering -- manufacturing engineering of all types -- must be brought into the mainstream of engineering science if the United States is to strengthen its international competitive position.

Automation

There is more to manufacturing engineering than process yields for integrated circuits, however, and more to be learned from the Japanese. In many industries, future competitiveness will flow from mastery of the design and operation of integrated production systems. We are only beginning to understand how to use computers in manufacturing. Although the technology is in its infancy, it is plain that systems integration -- making the pieces work together -- will be critical.

Factories are chaotic environments. An airplane is held together by hundreds of thousands of rivets and bolts. Many of the holes are drilled by hand. The rivets are set by hand. Not only is the labor expensive, but simple mistakes can cost a great deal of money if parts have to be scrapped or reworked. Automating this kind of factory production is a systems problem; those who master the technology first will reap the rewards. (I should mention that OTA is examining the job displacement effects of computer-based automation, and the implications for worker training and retraining, in assessments currently underway.)

It is possible to have excellent technology in terms of individual pieces of equipment -- robots that can see, multi-axis machining centers -- but not have an efficient system. The pieces must work effectively together. The Japanese have learned this lesson well, one example being their heavily publicized "just-in-time" production systems. Design engineering must also be integrated into the system. Design departments will no longer be able to simply tell manufacturing what they want. Products will have to be developed that take advantage of manufacturing capabilities. There is a great deal to be learned here from Japanese manufacturing, and not all of it has to do with quality circles.

Product Technologies

Creativity and innovation in Japanese technology hardly stop with manufacturing skills. Broadcast video tape recorders may have originated with Ampex and RCA, but it took many years of painstaking engineering development by Japanese firms -- summarized in a fascinating study by Richard Rosenbloom and the late William Abernathy, both of the Harvard Business School -- to create a mass-market product. During the 1960s, at least eight Japanese companies engaged in a heated competitive race to develop consumer VCRs. Matsushita entered pilot production first, in 1973, but withdrew because of unsatisfactory results. Two years later, Sony's Betamax finally opened the market. This machine represented the company's fourth generation of engineering -- the seventh generation if industrial models are included. The lesson? Japanese companies, competing aggressively with one another, persisted with consumer VCRs in the face of many disappointments, and now dominate the world market. The fact that they started with 1950s-era U.S. technology really had nothing to do with it.

There are many parallels in other industries. Early exports from Japan tended to be poorly designed, less than durable. When American consumers rejected them, Japanese companies found out why and reacted quickly. During the 1970s, Toyota and Nissan steadily revamped their product lines and built dealer networks -- learning from past mistakes in ways that European automakers did not. Today, Americans help design many of the cars produced in Japan. One day soon we may find Fujitsu or Nippon Electric developing microprocessors with the help of American engineers. Unlike many companies in the United States or Europe, Japanese firms show little reluctance to go beyond their own borders for technology and know-how that will give them a competitive edge -- easier, of course, when striving to catch up.

In semiconductors, American firms remain well ahead of their Japanese competitors in specialties such as microprocessor design, but, more generally, rough technological parity has existed for several years. Among the signs: National Semiconductor and Oki Electric have been cooperating in large-scale RAM (random access memory circuit) development; Zilog and Toshiba are exchanging technical information; Hewlett-Packard has purchased RAM technology from Hitachi. Despite combative rhetoric and persistent trade friction, this is an increasingly international industry, one in which technology flows to those who need it, can pay for it, and have employees who know what to do with it.

LEARNING FROM JAPANESE TECHNOLOGY AND SCIENCE

As these and many other examples show, at least some American businessmen have developed a sophisticated appreciation of the lessons to be learned from Japan. Will this be enough? Attend a meeting of the Society of Automotive Engineers and you will find employees of Japan's automakers not only coming here to learn, but giving technical papers -- more and better ones each year. Japanese automobile companies are pursuing clever, creative advanced design concepts -- e.g., in engines and engine control systems -- that will show up in production by the late 1980s. Frankly, I've found the papers from Japan a good deal more interesting than those from Detroit. Much the same is true in other technical fields; the number and quality of papers from Japan submitted for meetings of the Institute of Electrical and Electronics Engineers has increased markedly over the past five years.

Based on what Japanese companies are willing to talk about, in public and in English, the United States could benefit even more from good information on what is happening inside Japan. For a large multinational corporation with abundant technical resources -- or for an intelligence agency -- the development of a system for gathering and analyzing information on Japanese technology is relatively straightforward, the more so the narrower the field of interest. Different divisions of IBM no doubt mount independent efforts. Of course, this can be expensive. Japanese companies are renowned for their own information gathering systems, although no one seems to ask what it costs and whether Japanese companies evaluate the costs and benefits differently than American firms.

Regardless of the reasons, a surprising number of U.S. corporations, even among the larger multinationals, have neither offices in Japan nor information-gathering networks there. They may rely on consultants, Japanese trading companies, an occasional visit, the trade press. Sometimes they realize too late how good the competition has become. At this point, it will take American automakers at least a decade to catch up in the technology for designing and producing small cars.

The audience for information on Japanese technology and science ranges beyond private companies and the military and intelligence communities. It includes research workers in universities and the National laboratories. But if technology is, in any event, largely transferred by people, could the Federal Government play a useful role? I believe that it could, even where the primary consumers are in the private sector.

American industry includes tens of thousands of smaller firms that are far from self-sufficient technologically. Many of these companies could benefit from sound technical information regardless of whether it originated in Japan or the United States. I will not go into the needs of such companies further at this time; OTA addresses the subject at some length in a Staff Memorandum entitled "Development and Diffusion of Commercial Technologies: Should the Federal Government Redefine Its Role?" to be released later this month. I would be pleased to submit a copy of that Memorandum for the record, when it is available.

The Language Barrier

We have a long way to go toward an environment in which American engineers, scientists, and businessmen will have easy access to information on Japanese technology and science. How many Americans go to technical meetings in Japan, even those where English is spoken? Few travel even to technical meetings in Europe, where English is common. How many technical articles written in English cite the Japanese literature? How many textbooks used in U.S. engineering schools mention Japanese contributions? How many scholarships or prizes recognize joint achievement in engineering and language? How many Americans know that Japan's technology for boring tunnels through soft earth and faulted rock is the best in the world? How many civil engineers know it? Indeed, how many U.S. construction firms operate R&D laboratories?

Of course the language problem is a pervasive one. As Robert Gibson, head of the libraries at General Motors Research Laboratories, has pointed out, less than 20 percent of the Japanese technical literature -- regardless of the language in which it is written -- has been indexed or abstracted in English. And, while hardly any American engineers or scientists read Japanese (many more can handle Russian), 60 percent of the volumes in Tokyo University's engineering library are in Western languages.

Yet the situation is not so bad as it might seem. Japanese engineers and scientists routinely publish some of their work in English, not only in international journals but in those printed within Japan. Pick a technical subject almost at random, and it is safe to say that Japanese researchers have written useful papers, and in English. They attend international conferences, where English has become the standard language. It is not unusual to find that 15, even 20 percent of those at technical meetings in Europe or the United States have come from Japan. At the 1982 International Machine Tool Design and Research Conference, in England, Japanese visitors far outnumbered those from _any_ of the nations on the Continent. Japan's contributions may be less visible than they deserve to be because of our preoccupation with dramatic breakthroughs, the kind that lead to Nobel awards. However, the roots of a technologically competitive economy are nourished by a vast range of work, much of it unintelligible except to specialists; if it does not win prizes, that does not mean it is unimportant.

The Technical and Trade Literature

If technologies are in the end transferred by people, language and the technical literature nonetheless plays a major role. Homework comes first -- digging through books, journal articles, conference volumes, government reports, the trade press. It is important to discover what is already known, define the boundaries of a problem, locate the people working at the frontiers. Print media remain indispensable for this.

If we focus on published information, the first problem is one of sheer volume. Technical literature is highly redundant -- a lesson that libraries intending to build their Japanese collections need to appreciate. Like anyone else with a message to get across, engineers and scientists find repetition essential. Still, one often has to delve quite deeply into the literature before diminishing returns set in.

In terms of the Japanese literature, then, the first problem is one of discrimination. Any system for gathering, analyzing, and disseminating information must discriminate good from bad, or, less bluntly, operate with a set of decision rules based not only on quality, but on the costs of continuing to search. These costs have to be balanced against the probability of missing important pieces of information. Such judgements can only be made by technically competent people. While few American engineers or scientists read Japanese, interdisciplinary groups like those OTA has formed for assessing industrial competitiveness offer one route to useful evaluations.

Is it possible to translate everything, so that technically trained people could make their decisions based on an English version? Unfortunately, computerized translations are not yet practical. Costs are far too high if people do the work. There are some second-best alternatives: translating abstracts; concentrating on equations, numerical data, charts and graphs. Perhaps a Federal agency -- for instance, the Department of Defense -- could support a high-quality series of abstract and review journals, in which technical experts here would select Japanese publications based on their sense of the quality of the authors, on translated summaries, and on the many other clues that engineers and scientists use in evaluating research results. The aim might be a series of critical summaries, by field, along the lines of Applied Mechanics Reviews. I regard such an effort as an important first step in improving our access to information on Japanese science and technology.

The trade press poses a more difficult problem, largely because so much that is written has little value. The winnowing out quickly becomes very expensive, because it virtually demands people with expertise in a subject area who can also scan in Japanese. Fortunately, this is an area where the private sector will probably pick up much of the slack because the potential audience for trade and commercial news is much greater than that for hard science and technology. Already, many U.S. periodicals do a good job of covering business news from Japan.

WHAT CAN THE FEDERAL GOVERNMENT DO?

I pointed above to a possible first step for Government: sponsor a series of abstract and review journals. It also seems appropriate to expand the work of the National Technical Information Service, which might concentrate on government publications from Japan -- perhaps developing a review service for reports analogous to that for journals. The Federal Government might also continue its efforts to help U.S. companies gain access to Japanese patents.

There is more. The Federal Government could:

- Add technically trained people to the staff of the Tokyo embassy, and to consular offices, with responsibility for critically analyzing and evaluating Japanese technology. A much broader range of information is needed than collected by the military and intelligence communities.

- Provide financial support, not only for libraries with extensive Japanese language collections, but for the great majority of the engineering and science libraries in American universities which cannot even keep up with the English language literature. American engineering schools suffer, not only from obsolete and inadequate laboratory equipment, but from libaries that are cutting needed journal subscriptions for lack of funds.

- Offer financial aid to college-level students in technical fields who wish to learn Japanese, as well as to specialists in Japanese studies who wish to collaborate with technologists or to study economic and industrial questions.

- Support, through the National Science Foundation and other agencies, international travel, as well as technical exchange programs, for American engineers and scientists. U.S. representation at major international meetings has become shamefully low.

- Perhaps most important, proceed with the establishment of a network of centers for the development and diffusion of commercially-oriented technologies -- something the United States badly needs to strengthen its international competitiveness -- and include the acquisition and transfer to U.S. firms of foreign technologies in the missions of at least some of these centers.

I stress this last point because such centers -- as envisioned in the Stevenson-Wydler Act (P.L. 96-480) and discussed at length in the forthcoming OTA Staff Memorandum mentioned above -- would provide an institutional setting for American engineers and scientists to work actively with and learn from Japanese technology. That should be the ultimate goal.

Mr. MINETA. Thank you very much, Dr. Alic.

Mr. Marino.

Mr. MARINO. Yes. We also appreciate the opportunity to contribute to the solution of the important problems the committee is attempting to tackle.

I will provide the committee some background and Mr. Braegelmann will follow with a lot of the specifics.

Basically, the Foreign Broadcast Information Service probably translates more information than the rest of the U.S. Government combined. FBIS' normal coverage of foreign media sources includes selection, translation, and publishing of articles from various foreign scientific journals. Included in this is a substantial amount of Japanese language material.

Along with technical trade journals, FBIS' Joint Publications Research Service, known as JPRS, translates selected Japanese monographs, books, and newspaper articles.

Mr. Braegelmann will go into the details of how we choose the articles to translate and how we go about doing what we do.

There is an enormous volume of material begging for translation, suffice to say we cannot meet the demand of our consumers. We work hard at choosing those articles which hit on cutting-edge issues of technology, and once identified, translate them for the U.S. Government community.

Our principal coverage areas are electronics, focusing in on microelectronics; communications, both the theory and techniques; computer science, basically fifth-generation related technologies; space technology, robotics, biotechnology, agrotechnology, medicine, and research into basic sciences such as physics, chemistry, and so forth.

Because of the demand, we have recently begun a new publication devoted exclusively to Japanese science and technology translations. It is a Government-use-only document, and it comes out about once a week.

I know all this sounds very sophisticated and complete but it really isn't. We make do with what we have in terms of people; Japanese linguists are hard to find and recruit.

Generally, we work at a problem that almost seems insurmountable. I will turn the floor over to Mr. Braegelmann, and he will go into more of the details.

Thank you.

[The biographic sketch of Mr. Marino follows:]

February 1984

PETER A. MARINO

Date of Birth: February 3 1942

Place of Birth: Englewood, New Jersey

Education: B.S. in Physics, Rollins College, 1963

M.S. in Physics, Pennsylvania State University, 1970

Graduate work in mechanical engineering, physics, and electrical engineering, Pennsylvania State University

Work Experience: 1963 - 1967
Research and Development Center, Pratt Whitney Division, United Technologies Corporation; various positions including Propulsion Systems Scientist and Senior Engineer for acoustic design and development.

1967 - 1968
Applied Research Laboratory, Pennsylvania State University; research in advanced ordnance systems and ASW technologies.

1968 - 1970
Mechanical Engineering Department, Pennsylvania State University; acoustics instructor.

1970 - 1983
Central Intelligence Agency; has held managerial positions in several components, directing highly technical programs and overseeing budget and contract efforts; Deputy Director, Foreign Broadcast Information Service since February 1983.

Personal: Married, three children - two boys and one girl

Mr. **Braegelmann.** We currently scan and select articles for translations from some 250 current Japanese scientific and technical publications. Virtually all of these are in the Japanese language. The publications are subscribed directly from the publisher and then, as described earlier, scanned and selected for articles against criteria that have been formulated by various U.S. Government agencies.

The articles are then sent out to be translated by freelance translators, under contract, and published in the Joint Publications Research Service report that Mr. Marino mentioned.

Copies of this report, containing material not subject to the original copyright restrictions of the Japanese, are then publicly available through the NTIS, National Technical Information Service.

Distribution of all reports, whether they be unrestricted or Government-use-only, are made free of charge by JPRS to all interested Government subscribers.

While the interest in the scanning, and selection, and processing of JPR—of Japanese S&T information is a longstanding one, our efforts have been intensified considerably recently so that the total amount of material published has gradually increased from some 2,000 pages annually to about 6,000 pages currently. To the extent that resources would allow, we, of course, would hope to expand even further this coverage.

A logical concern in a translation effort of this size is avoidance of duplication. This concern extends beyond the avoidance of duplication within our own activity to the translation of other Government agencies, of which we have heard something yesterday at this hearing.

Therefore, we have a consolidated translation survey office within FBIS, that maintains an automated bibliography of all Japanese and other foreign language materials that have been translated that are of one page in length or more. That's whether we did the translation ourselves or anyone else within the Government.

The other Government components notify us when they undertake a translation and when it is completed, but more importantly, this bibliography that we have on the sources available to other Government agencies, they will check with us to see if an article or a monograph has been translated and, if so, by whom.

The index that I just described dates back to 1949 and contains some 1.5 million entries. Now mind you, that's for all languages and it would be very difficult to—to sort out just what percentage or how many of those are from Japanese publications.

And just as a matter of record, two-thirds of the some 200 checks against this index that are made each month, do come from other Government departments or agencies, and it's estimated that this check saved the U.S. Government $1.9 million last year in prevented duplication of translation.

Now, I guess anyone who plans to expand coverage of Japan S&T information has mentioned the one major obstacle, and that is the difficulty of finding language qualified, truly bilingual—Japanese-English bilingual translators or people in the marketplace.

The other problem is the vast selection of Japanese S&T information that's available. Now, common agreement used to be that there are some 9,000 S&T publications published in Japan; yesterday the figure of 10,000 was used. It probably has gone up within the last year or 2 to that extent. And only about 25 percent of these are in English.

But I think it would be incorrect to assume that, therefore, 25 percent of all information on Japan S&T is available in English; that is not necessarily the case. Experience has shown that the English language publications from Japan are usually issued long after the development that's being reported has actually taken place.

And the simple explanation that I come up with for that is the fact that the Japanese have problems getting their material translated into English also.

And, moreover, most of the English language accounts of developments are not as complete as the Japanese language versions. This is particularly true of the daily and weekly English language publications from Japan.

So, any meaningful expansion of coverage has to involve the translation of Japanese language publications.

And yesterday, it was again described, and I will reiterate, that Japanese is indeed a very difficult language to master. It requires many years of intensive study. And if you do find someone who has both the Japanese and the English skills, plus the ability to translate, which is indeed a separate art beyond just knowledge of both languages, you then have to also find, does that person have an S&T substantive background to handle the material. If not, is he or she willing to acquire this kind of expertise?

So, in the face of this, I would suggest, perhaps, that the best hope for alleviating the problem of getting material translated into English is to rely on machine translation. Now, machine translation is not here yet. And I think it will be agreeable with everyone that with the statement that we would—for many years, will not have a perfect translation coming out of a machine. But a machine is able to provide what we would call content accurate translations that would be useful to a consumer.

We have several machine translation projects that are ongoing in this country and, of course, Japan has many more going. I won't go into the details of these systems at this point unless somebody would like to do so.

That would be all, sir.

[The biographical sketch of Mr. Braegelmann, plus titles of Japanese publications on coverage in FBIS' follows:]

February 24, 1984

BIOGRAPHIC SKETCH

Cyril P. Braegelmann

Date of Birth:	July 28, 1930
Place of Birth:	Richmond, Minnesota
Military Experience:	U.S. Army, 1951-1954. Completed one-year Chinese Language program at Defense Language Institute, Monterey, California
Education:	BA degree in Far East Asia Studies, University of Minnesota, 1957 Graduate studies in Public Management, The Pennsylvania State University, 1974; The University of Washington, Seattle, 1975-1976
Work Experience:	Chinese documents officer and translator with the Foreign Broadcast Information Service, 1958-1974. Chief, Near East/Asia Division from 1976-1977 Served as Chief of the Joint Publications Research Service, a contractual translation facility, 1978-1982 Chief, Near East/Asia Division, 1982-present Deputy Member, U.S. Board on Geographic Names, 1982-present
Personal:	Married, three children

TITLE OF JAPANESE PUBLICATIONS ON COVERAGE IN FBIS

Kyoto VOICE
Osaka MATSUSHITA DENKO GIHO
Osaka NATIONAL TECHNICAL REPORT
Tokyo AEROSPACE
Tokyo AJIA AFURIKA SHIRYO TSUHO
Tokyo AJIA KORON
Tokyo AKAHATA
Tokyo APIC
Tokyo ASAHI EVENING NEWS
Tokyo ASAHI JANARU
Tokyo ASAHI NENKAN
Tokyo ASAHI SHIMBUN
Tokyo BIRION
Tokyo BOEI ANTENA
Tokyo BOEI HAKUSHO
Tokyo BOEI HANDO BUKKU
Tokyo BOEKI TO KANZEI
Tokyo BUNGEI SHUNJU
Tokyo BUSINESS JAPAN
Tokyo CHUO KANCHO CHIHOCHO KAMBU ICHIRAN
Tokyo CHUO KORON
Tokyo DAILY YOMIURI
Tokyo DEMPA JIHO
Tokyo DEMPA SHIMBUN
Tokyo DENKI
Tokyo DENKI SHIMBUN
Tokyo DENKI TO GASU
Tokyo DENKI TSUSHIN NENKAN
Tokyo DENSHI
Tokyo DENSHI DENWA
Tokyo DENSHI GIJUTSU
Tokyo DENSHI KAGAKU
Tokyo DENSHI KOGYO NENKAN
Tokyo DIAMOND'S INDUSTRIA
Tokyo DIGEST OF ENGLISH INDUSTRY AND TECHNOLOGY
Tokyo EA WARUDO
Tokyo ECONOMIC EYE
Tokyo ECONOMICS IN JAPAN CERP
Tokyo ECONOMY SOCIETY POLICY

Tokyo EKONOMISUTO
Tokyo ENERUGI
Tokyo ENERUGI FORAMU
Tokyo ENERUGI SEISAN JUKYO TOKEI GEPPO
Tokyo EREKUTORONIKUSU
Tokyo FAINANSU
Tokyo FUJI JIHO
Tokyo FUJITSU
Tokyo FUJITSU SCIENTIFIC AND TECHNICAL JOURNAL
Tokyo FUNE NO KAGAKU
Tokyo GAIKOKU KAISHA NENKAN
Tokyo GEKKAN ASAGUMO
Tokyo GEKKAN EAROSUPESU
Tokyo GEKKAN SHAKAITO
Tokyo GEKKAN YORON CHOSA
Tokyo GENDAI
Tokyo GENDAI NO ME
Tokyo GENDAI YOGO NO KISO CHISHIKI
Tokyo GENSHIRYOKU HAKUSHO
Tokyo GENSHIRYOKU KOGYO
Tokyo GENSHIRYOKU NENKAN
Tokyo GENSHIRYOKU SANNGYO SHIMBUN
Tokyo GIJUTSU TO KEIZAI
Tokyo GIKKEN GEPPO
Tokyo GINKO JIHYO
Tokyo GUNJI KENKYU
Tokyo HANASHI NO TOKUSHU
Tokyo HATSUMEI
Tokyo INDUSTRIAL REVIEW OF JAPAN CERP
Tokyo JAPAN COMPANY HANDBOOK
Tokyo JAPAN ECHO
Tokyo JAPAN ECONOMIC JOURNAL
Tokyo JAPAN ELECTRONICS ALMANAC
Tokyo JAPAN QUARTERLY
Tokyo JIDOSHA GIJUTSU
Tokyo JIEITAI SOBI NENKAN
Tokyo JIHYO
Tokyo JINJI KOSHINROKU
Tokyo JITSUGYO NO NIHON
Tokyo JIYU
Tokyo JPE AVIATION REPORT
Tokyo KABUSHIKI NIPPON
Tokyo KACHIARU JOHO
Tokyo KAGAKU ASAHI
Tokyo KAGAKU GIJUTSU HAKUSHO
Tokyo KAGAKU SHIMBUN

Tokyo KAIGAI SHIJO
Tokyo KAIJO HOAN HAKUSHO
Tokyo KAIYO KAGAKU
Tokyo KAIYO KAIHATSU
Tokyo KANKAI
Tokyo KEIEI KONSARUTANTO
Tokyo KEISATSU HAKUSHO
Tokyo KEISOKU TO SEIGYO
Tokyo KEIZAI HAKUSHO
Tokyo KEIZAI KENKYU
Tokyo KEIZAI TO GAIKO
Tokyo KEIZAIKAI
Tokyo KIKAI GIJUTSU
Tokyo KIKAI KEIZAI KENKYU
Tokyo KIKAI SEKKEI
Tokyo KIKAI SHINKO
Tokyo KIKAI TO KOGU
Tokyo KIKAN GENDAI KEIZAI
Tokyo KINO ZAIRYO
Tokyo KINYU TO GINKO
Tokyo KINZOKU JIHYO
Tokyo KOAN CHOSA GEPPO
Tokyo KOGIKEN NYUSU
Tokyo KOGYO GIJUTSU
Tokyo KOGYO ZAIRYO
Tokyo KOKU GIJUTSU
Tokyo KOKU JANARU
Tokyo KOKU TEMBO
Tokyo KOKUBO
Tokyo KOKUMIN SEIJI KENKYUKAI HO
Tokyo KOKUSAI KEIZAI
Tokyo KOKUSAI SHIGEN
Tokyo KOKUSEI SHIKIHO
Tokyo KOKUYU TETSUDO
Tokyo KOMEI
Tokyo KOMPUTA DAIJESUTO
Tokyo KOMPYUTOPIA
Tokyo KOTSU GIJUTSU
Tokyo LOOK JAPAN
Tokyo MAINICHI DAILY NEWS
Tokyo MAINICHI SHIMBUN
Tokyo MARU
Tokyo MITSUBISHI DENKI GIHO
Tokyo NAINEN KIKAN
Tokyo NASDA NYUSU
Tokyo NEC GIHO

Tokyo NICCHU KEIZAI KYOKAI KAIHO
Tokyo NICCHU NISSO BOEKI HANNENPO
Tokyo NIHON KAISHA ROKU
Tokyo NIHON KEIZI SHIMBUN
Tokyo NIHON KOGYO SHIMBUN
Tokyo NIHON KOKU UCHU GAKKAISHI
Tokyo NIHON NO KAGAKU TO GIJUTSU
Tokyo NIKKAN KOGYO SHIMBUN
Tokyo NIKKEI BAIOTEKU
Tokyo NIKKEI BIJINESU
Tokyo NIKKEI EREKUTORONIKUSU
Tokyo NIKKEI KAISHA JOHO
Tokyo NIKKEI KOMPYUTA
Tokyo NIKKEI MEKANIKARU
Tokyo NIKKEI PASOKON
Tokyo NIKKEI SANGYO SHIMBUN
Tokyo NIKKO FORAMU
Tokyo NIPPON NO YOSAN
Tokyo NIR SEARCH
Tokyo NOGYO KYODO KUMIAI
Tokyo NOGYO TO KEIZAI
Tokyo ORGANIZATION OF THE GOVERNMENT OF JAPAN
Tokyo ORIENTAL ECONOMIST
Tokyo OTOMEISHON
Tokyo OUTLINE OF THE WHITE PAPER ON SCIENCE AND TECHNOLOGY
Tokyo PUROMETEUSU
Tokyo ROBOTOPIA
Tokyo ROCKET NEWS
Tokyo RODO JIHO
Tokyo RYUDO
Tokyo SANDE MAINICHI
Tokyo SANGYO TO KEIZAI
Tokyo SANKEI SHIMBUN
Tokyo SANZENRI
Tokyo SEIFU KANKOBUTSU GEPPO
Tokyo SEIKAI ORAI
Tokyo SEIKEIJIN
Tokyo SEIRON
Tokyo SEKAI
Tokyo SEKAI KEIZAI HYORON
Tokyo SEKAI KOMPYUTA NENKAN
Tokyo SENSA GIJUTSU
Tokyo SENTAKU
Tokyo SERAMIKKUSU
Tokyo SHAKAI SHIMPO
Tokyo SHIGEN TO ENERUGI

Tokyo SHIGEN TOKEI GEPPO
Tokyo SHIMBUN GEPPO
Tokyo SHINNIHON
Tokyo SHOKUN
Tokyo SHUKAN ASAHI
Tokyo SHUKAN DAIYAMONDO
Tokyo SHUKAN JIJI
Tokyo SHUKAN YOMIURI
Tokyo SHUPPAN NENKAN
Tokyo TOITSU NIPPO
Tokyo TOKI NO KEIZAI
Tokyo TOKINO KADAI
Tokyo TOSHI KEIZAI
Tokyo TOSHI SODAN
Tokyo TOSHIBA REBYU
Tokyo TOYO KEIZAI
Tokyo TSUSAN JANARU
Tokyo TSUSANSHO KOHO
Tokyo TSUSHIN HAKUSHO
Tokyo TSUSHO HAKUSHO
Tokyo UCHU KAIHATSU IINKAI GEPPO
Tokyo USHIO
Tokyo WILL
Tokyo YOMIURI SHIMBUN
Tokyo ZAIKAI
Tokyo ZAIKAI KORON
Tokyo ZAIKAI TEMBO
Tokyo 45 +
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Mr. **Mineta**. Thank you very much, Mr. Braegelmann and Mr. Marino.

OK, let me get back to just this whole issue of the plethora of information that's available.

Are we maybe not concentrating our efforts in a certain targeted manner but are trying to address this too broadly, trying to cover the full spectrum of things that are available?

Dr. **Alic**. I think that much of the discussion on acquiring information on Japan's science and technology is confused with other literature. The engineering and science journals in which research results are presented to the international community of technical professionals is confused with more general business and trade information.

I think much of the hard technical information is available but its availability is truncated because the Japanese publish only a certain subset of their work, generally the work that they are most proud of, in English.

But if you are looking for a comprehensive view of the field, then it may be important to look at the foreign language literature, whether it is in Japanese, or French, or German, or Russian.

There is, of course, a huge outpouring of business and trade information from Japan, as from other countries, of highly variable quality. And the screening and the discrimination of that kind of information is a much different problem than the screening and discrimination of hard technical literature.

I think that the technical literature itself is a more manageable problem and one that is better under control simply because Japanese scientists and engineers, like those in any other country, must recognize that English is now the international language for technology. And so, if they want recognition from their peers for their work, they have to publish in English.

Trade and business information is a different problem. It is harder to decide what is important; there is much more of it; and it is, I think, necessary to adopt some—some second-best solutions, in effect, to deal with that mountain of information, to screen it.

And I think that's a problem that really cannot be addressed by expanding our efforts and translating volumes of information because we already have, if we're, studying problems of competitiveness, as OTA has in the past, vast realms of information in the English language, far too much to digest and analyze already. The problem is figuring out what is the good information and discriminating that from the bad information.

Mr. **Mineta**. Well, that's what I'm trying to get at, though.

When you say they're highly creative; I wonder whether or not that creativity is being directed at production rather than over here at the research aspects of basic science, that they are concentrating more on how do we take the technology as being developed here and make it productive; make it available for some manufacturing operations; make it available for consumer products; and really concentrate on that area. And—but they're not really strong on basic science in terms of any innovative things that they might be doing.

So that their creativity is really on the—I guess you might say the production end. To that extent, are we getting even with the publications that are available? Are we getting a good cross section of that material?

Dr. ALIC. I cannot speak to Japanese abilities in basic science. I am an engineer by training, not a scientist. I can speak to Japanese abilities in engineering research which merges and overlaps the scientific research; and there my judgment is that the Japanese, for two decades and more, have been doing excellent, high quality, innovative, creative research.

Now, their style is a little different than Western researchers; they tend to emphasize experimental and empirical work, perhaps to a greater extent than researchers in Europe or the United States. But the work they have been doing for many years is at a high level. And they've made major contributions to any number of fields.

Mr. MARINO. If I can interrupt for just a second——

Mr. MINETA. Go ahead, of course.

Mr. MARINO [continuing]. And reinforce the—I think it's a mixed bag. I think it depends on the technology that one is concerned about. But if you look at the computer science area, for example, and even in the microelectronics area, the Japanese do an excellent job in terms of research.

Mr. MINETA. That's a result of their targeting. I mean, they decide that they are going to isolate this area and that they are really going to go after it. They did that to our consumer electronics business; they've done that with our automobile industry; now they are doing it in terms of fifth-generation computer/artificial intelligence; and microelectronics, that whole area.

Mr. MARINO. Yes, and I think they're also heading now in the biotechnology——

Mr. MINETA. That's right.

Mr. MARINO [continuing]. Area.

Mr. MINETA. That's right.

Mr. MARINO. So, yes, I—I agree with you in the sense that they—they have their goals pretty clear in their mind and they concentrate a big effort to achieve those goals. And in, say, fifth-generation computer work, their goals are to turn out a supercomputer. And to turn out a supercomputer requires research in the artificial intelligence natural language processing technologies, and they are concentrating their computer science efforts in those areas. Yeah, I agree, and they do a good job at it.

Mr. MINETA. My point is that they didn't come up with the RAM, but they've taken that technology to the 16K and the 64K to the 256K, and they occupy about 75 percent of the 64K RAM market today. And with that major share, they can then use that to break into the next generation and to——

Mr. MARINO. That's correct. I agree with that, except if—I guess what you're saying is that they don't come up with the initial breakthrough, like the discovery of DNA. But that's not going to prevent them from using the biology discoveries to—to get into the genetic engineering field, and that's right. But there is a serious amount of research that takes place between the discovery of, say, DNA, to the splicing of the first gene. And the Japanese are very capable of doing that. But you're right, in the past couple of years, they haven't been known for the basic science breakthroughs. I think that's probably correct when you compare them to the United States.

Mr. MINETA. Yes.

Mr. MARINO. And that's also true in microelectronics. I mean, they see that you can build a small rent-a-maxis memory, and then they concentrate on building a bigger one, or a better one.

Dr. ALIC. May I offer a couple of comments on this subject?

First of all, I emphasize that technology is not science. They are fundamentally different activities. They overlap but the linkages are fairly indirect and loose.

Second, in my experience, in many of the less glamorous, less known, but critical technologies for a competitive, modern, industrial economy the Japanese have been very good and very creative for many years. It does not stop with manufacturing skills, and they are very good at manufacturing.

But I might offer an example. I, at one point, worked in a field of engineering called fretting fatigue. At the time I entered that field in the middle seventies, there were about four or five groups in the world studying that subject. It's an important one; it's well known; but it was a very difficult area to work in.

One of those groups was in Japan, one was in the United Kingdom, and there were a couple in the United States. I quickly found that what I considered the best work done within the last 10 years in that narrow field—but most technical fields are narrow, and you have to be a specialist to understand what's happening and know what it's good for—was the work done by two Japanese researchers at what would generally be considered a second rate university in Japan. It was the best. Better than being done in the United Kingdom, better than being done in the United States, better than being done in Russia—something that nobody else had even attempted before.

I also point out that their work was published in an English language international journal, and so was accessible to me.

I think that example could be replicated many times in other equally narrow and specialized technical fields. But it is those technologies that nourish the roots of an internationally competitive economy.

Mr. MINETA. Just out of curiosity, in that example, was that being funded by the Japanese Information Center for Science and Technology, or was that done by the university itself? Where was their funding coming from?

Dr. ALIC. As I recall, it was funded internally by the university in Japan, not by any government agency.

Mr. MINETA. And to what extent would you say that either copyright laws, or antitrust laws, make a big difference in this whole area, either in terms of the research that gets done or in the publication and the availability for use by others?

Mr. MARINO. Well,——

Mr. MINETA. Mr. Marino?

Mr. MARINO [continuing]. From our standpoint, we do—as I mentioned, we publish a—a, a weekly publication called Japanese Science and Technology, which is a translation from the trade journals of technology that we consider important technology. And its published under the restriction of for Government-use only, because we are constrained by the international copyright laws to distribute them to the public.

They come up to this committee, I know—and they go out to all the Government consumers as instructed. But that's the best we can do as a Government agency considering that we're under the caveat of the international copyright laws.

So from that standpoint, yes, they are restrictive because it prevents universities and industry from getting the information unless there's a—a strong Government need for that to take place. And so we, you know—it's restricted. The copyright laws—international copyright laws are restricted, from that standpoint.

Mr. MINETA. There have been some suggestions that before embarking on any new effort in this area, that a comprehensive inventory of existing collection translation and distribution activities ought to be made.

I am wondering if you would both react to that suggestion.

Mr. MARINO. Why don't you go first?

Dr. ALIC. I believe that the key is screening; it's determining what's important and what can be disregarded. And if it turns out that an inventory is a necessary preliminary step before that kind of quality control effort can begin, then I would think that would be important. Otherwise, I think it's more desirable to get on with the work of diffusing what we know is out there to American industry, because American industry, I think, can learn from it right now.

Mr. MARINO. I hate to put it this way, but I think doing an inventory would be a waste of time. The technologies are going so fast and moving so fast that the more time you spend looking in the past and worrying how you did the job previously, the less time you are going to spend on the emerging technologies.

I just don't see where it's constructive unless it provides some insight into the way people are organized to do it, but not in terms of what it can contribute to the technology knowledge of this country vis-a-vis Japanese S&T.

Mr. MINETA. How important is the not-invented-here syndrome? A lot of times we take so much pride in our own ability to do things that American scientists, engineers, and business people get sort of a myopic view about things and don't look at the broader sphere to take a genuine interest in some of the important advances that are being made in engineering and science in Japan.

Do you find this a problem at all? Are we stumbling over our own national pride?

Mr. MARINO. I don't know that I can answer that intelligently but it's my sense that American industry, in particular, is becoming more and more aware of the contributions the Japanese scientists and engineers are making to the technology area and are worried a lot about it. And that worry probably overcomes whatever national pride that, or would—not-invented-here attitude here existed. That's just a sense that I have. I don't know whether you've got——

Dr. ALIC. I think that the not-invented-here syndrome works just about everywhere. I think, perhaps, it's not so strong in Japan as it is here. I don't know the reasons for that. I don't think that that's a big part of the problem.

Mr. MINETA. Mr. Valentine.

Mr. VALENTINE. I don't have anything.

Mr. MINETA. Mr. Chairman.

Mr. WALGREN. I don't have any questions at this time.

Mr. MINETA. Mr. Chairman, let me ask, if I might, about the Japanese Information Center for Science and Technology. Should we have a similar type agency? The question is whether or not the Department of Commerce ought to be structured more like MITI. We are looking at their publications; we are looking at restructuring things in our own Government to be able to target better what we're after. Is it something that we ought to be considering in terms of a JICST?

Dr. ALIC. Let me begin by pointing out that OTA has testified on that subject before Senator Roth's committee in the context of S. 121 to establish a Department of International Trade and Industry.

In that testimony we stressed the need for the U.S. Government to develop a better analytical capability for understanding international trends in technology, in trade, and industrial competitiveness.

Our view is that the technical information is a critical element in developing the kind of analysis that would be necessary should the Federal Government embark on a more coherent approach to formulating policies that affect industrial performance.

Mr. MINETA. I'm sorry, go ahead.

Dr. ALIC. Well, that——

Mr. MARINO. I don't really have anything to add to that.

Mr. MINETA. Do we have any idea in this whole sphere of how much is done by the private sector, how much is done by governmental agencies? And in looking at S&T material translating and then disseminating, how much is done by private sector, how much is done by governmental agencies?

Mr. MARINO. I think we have a good feel for what Government agencies are doing, we, FBIS. The private sector is hard to guess at because intuitively I have a sense that some of the big semiconductor companies, for example, are doing it on their own where they feel it's necessary. And—and when they do that they don't make that readily available or—or let us know that they are doing it. Probably more in the private sector than one would guess.

The Government is doing the best it can, again going back to what I said earlier, in terms of the resources that are really available. And I don't mean resources in terms of providing more money, providing more anything. It's just that the—there's a certain number of Japanese linguistics/technologists and the Government has the opportunity to hire a certain percentage of those people and they—we probably hire a higher percentage of those people than we do of other disciplines. And I—I—so I think the Government does it—the best job it can. In the open market the Government's documents are—there's a—there are more open market Government documents than are private-sector documents. But my suspicion is that some of the industries, like I said earlier, are doing it on their own and not making that known to the rest of the community.

I don't know if Dr. Alic agrees with that but——

Dr. **Alic**. Our experience has certainly shown that many American companies have pretty sophisticated sources of information in Japanese science and technology. There are an even larger number of American companies that have remarkably unsophisticated knowledge of Japanese science and technology and it's the latter category that I think needs to have available information. As I said earlier, not only on Japanese technology and science, but on technology and science from the United States, from the Soviet Union, from Western Europe.

We have a serious problem in our technological infrastructure in this country, in our view. And that is diffusing technology to people who need it. It is just expecting too much today for companies, except the very largest, to be self-sufficient in their technology. There is too much there. And they need the help of the Federal Government, that's our view.

Mr. **Walgren** [presiding]. If the gentleman would yield.

Mr. **Mineta**. Sure.

Mr. **Walgren**. On what do you base the feeling that these larger companies have very sophisticated access to their Japanese interests? One instinct for the performance of large companies in our society is that they don't really get ahead of the curve. And if they are large, they must be somewhat successful and, therefore, their bureaucratic structure would lose the incentive to break new ground.

Is this just a feeling that you have—that we should have confidence that American firms do have, as you say, very sophisticated access?

Dr. **Alic**. Some do and some don't, that's the point that I was making. And I don't think that one can generalize from the size of the firm or the field that they're in whether they do or do not have a very deep understanding of what's happening in Japanese technology.

Some small companies do an excellent job of learning what their competitors are working on and what is available in other countries; and some large American companies don't make much of an effort. It's a mixed bag.

Mr. **Marino**. If I can answer that. I didn't want to leave the impression that I thought our industrial base was capable of going out and doing it on their own. I think some have and they have done it for their own special interests. But—but those few that have done it, don't necessarily serve the interests of the rest of the United States.

Mr. **Mineta**. Dr. Harris, I was wondering since you've done a lot of the work here, and not only for the foundation of this statement—did you participate in the other study on international competitiveness in electronics?

Dr. **Harris**. Yes, I did.

Mr. **Mineta**. And would you say that the processing engineering part of it is where our shortfall lies?

Dr. **Harris**. I think that I would prefer to let Dr. Alic answer the question on strength and weaknesses of Japanese industry in the electronics field.

Dr. ALIC. The Japanese are very good in processing technology for integrated circuits. They are getting much better in electron-device design as well. I think that in the future if they find they need to go elsewhere, say, for integrated circuit designers, the so-called superstars who can develop new generations of products, the kind of people who did develop the dynamic RAM or the microprocessor—they'll hire Americans. That's what Japanese automobile firms have done to design automobiles that will appeal to American consumers—they've hired American engineers and stylists.

Mr. MINETA. I understand that Toyota design center's in California?

Dr. ALIC. Yes, it is.

Mr. MINETA. And yet, in terms of the manufacturing process, GM is willing to go into a joint venture to find out from Toyota's engineers and their industrial designers how to build a car.

Dr. ALIC. I believe that we have a very serious problem in manufacturing technologies in this country. It has not been given a high priority by the private sector, or by the Federal Government in support of R&D; it has not been given a high priority by our universities. It's a critical area for cost control; it's going to be more critical in the future, as we move toward computer-integrated manufacturing systems, because the key to making an integrated production system function well is integrating the pieces. And that is something that all the evidence indicates the Japanese are ahead at making those pieces work together. That's really what we're talking about when we praise their capabilities in manufacturing engineering.

Mr. MINETA. Thank you very, very much.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Mr. Mineta.

Are there other thoughts to raise?

Well, on behalf of the committee, we want to thank you very much for your contribution and for being a resource to us.

Mr. WALGREN. The next panel is made up of Dr. Sam Coleman, the associate director for the office of program development at the North Carolina Japan Center in Raleigh; Clark Johnson, chairman of the board of Vertimag Systems Corp., and Michael Majcher of Xerox Corp.

I would like at this point to yield to my colleague from North Carolina, Mr. Valentine.

I understand that Dr. Coleman is a constituent of Mr. Valentine and I'd like to simply say at the outset that a committee benefits from the contribution of its members. And we are really pleased that we have somebody from your District to make a contribution on this subject.

STATEMENTS OF SAMUEL COLEMAN, PH.D., ASSOCIATE DIRECTOR FOR RESEARCH AND DEVELOPMENT, NORTH CAROLINA JAPAN CENTER, NORTH CAROLINA STATE UNIVERSITY; CLARK E. JOHNSON, JR., CHAIRMAN OF THE BOARD, VERTIMAG SYSTEMS CORP., MINNEAPOLIS, MINN., ON BEHALF OF THE MAGNETICS SOCIETY OF THE INSTITUTE OF ELECTRICAL & ELECTRONICS ENGINEERS, INC., AND MICHAEL D. MAJCHER, MANAGER, TECHNICAL INFORMATION CENTER, XEROX CORP., WEBSTER, N.Y.

Mr. VALENTINE. Thank you very much, Mr. Chairman.

I'm sorry that Dr. Coleman, according to the address shown on his biographical sketch is not yet a constituent of mine. I want to talk to him about that problem today. [Laughter.]

He lives in Raleigh and we are neighbors. But I'm happy, as I believe I am the only North Carolinian on this committee, Mr. Chairman, to have an opportunity to welcome to the subcommittee Dr. Sam Coleman. He is associate director of North Carolina Japan Center, which is a part of North Carolina State University, which, in turn, is one of the basic foundation parts, I believe, of Research Triangle Park, which is about 75 percent in my district; and which means so much to the State of North Carolina, and I believe to the entire Union.

So I'm just happy to have this opportunity to introduce you, Dr. Coleman, to the chairman and members of the committee, and welcome you here.

Dr. COLEMAN. Thank you very much.

Mr. WALGREN. Well, let me say as we start that your written statement will be made part of the record. Perhaps Mr. Mineta went over this ground, but your comments in writing are very welcome and you may submit addendums that you think should be included in the record for the consideration of the staff and the members of the committee. And so please feel free in your oral testimony to focus on those points that you feel cry out for underlining and discussion.

I'm very glad you're here, and why don't we proceed in the order in which we called the names. We would be most happy to hear your testimony in whatever way you feel most effective.

Dr. Coleman.

Dr. COLEMAN. Thank you very much.

I'm very pleased and honored to testify here today. And very pleased, too, to have been introduced by Mr. Valentine. I hope that whatever I say here is going to prove of value to the committee.

A minor correction here. They have down that I'm associate director for office and program development. Actually, it's research and program development. Although I'm sure everybody here would agree with me that a developed office is essential to get any research and program development done.

I'd like to begin by briefly introducing the Japan Center and the institution in which it's housed, the North Carolina State University at Raleigh.

The Japan Center was established in 1980 by the State of North Carolina to promote the State's economic and academic ties with Japan. It was located at North Carolina State University, which, as

Mr. Valentine had pointed out, is one of the three universities that makes up the research triangle area of North Carolina. North Carolina State University is the most active of these three universities with area industry and research agencies.

Placing the center in North Carolina State University, I believe, reflects the planners' desires to draw upon the university's strengths: science and technology, agriculture and engineering, and in public service, through extension activities.

I'd like to begin by talking about something that is not a problem of ours at all, and that's the issue of motivation among our faculty and students regarding what's going on among their colleagues in Japan in science and technology.

In November 1982, we conducted a survey among all of our rank faculty, and we were very gratified by the results; not only in the extent to which our survey was answered, but to the extent to which our faculty gave excellent evaluations to the work that their Japanese colleagues are conducting.

Those excellent evaluations were given not only by seven of the eight departments in our school of engineering, but in a broad array of scientific and technological departments. I'll just list a few of them for you: botany, biochemistry, plant pathology, marine earth and atmospheric sciences, microbiology, wood and paper science, and textile chemistry.

About a fourth of the respondents said that they had some form of professional contact with Japanese information sources. But over a third said that they were interested in having such information but they currently lacked the channels for it.

If the committee is interested, I would be glad to submit a copy of the report that resulted from that survey.

The Japan Center has given Japanese language education to a hand-picked group of these faculty: 30 of them. These faculty who have taken Japanese language education from us have then been sent to Japan for one semester of professional work; 10 of those faculty are in engineering or in the sciences.

As for our students, as of last fall, our university had 72 students enrolled in Japanese language courses which makes us the largest Japanese language program in the Southeastern United States.

But what I'd like to point to that makes our program noteworthy is the fact that two-thirds of those students are in science or engineering curricula.

And like MIT, we have begun an internship program, an industrial co-op program although, ours is on a much more modest scale. We have two North Carolina State students who are now doing internships for one semester at Japan IBM's Fujisawa Development Laboratory. Both of these students are North Carolina natives, both of them have excellent track records in the Japanese language.

And I might note, too, that we insist that any student we put on a plane and send to Japan have that commitment to the Japanese language, because it makes no sense to just take any student in science and technology and send them to Japan without preparation.

I'd also like to note that Japan IBM is taking care of the costs of this trip, and of their support while in Japan.

[The report mentioned above follows:]

JAPAN AND NORTH CAROLINA STATE UNIVERSITY

Occasional Papers of the North Carolina Japan Center

No. 2

Samuel Coleman

November 1983

SUMMARY

A November 1982 survey of rank faculty at North Carolina State University reveals that our university is very receptive to more ties with Japanese institutions and could benefit greatly from them.

Responses: 819, a return rate of 59 percent
(1,384 forms distributed)

*23 percent of the sample reported some form of current professional involvement with Japanese colleagues.

*30 percent of the sample gave an "excellent" rating to Japanese research in their field. Ratings were especially high not only in the School of Engineering but within a variety of departments in other schools as well, such as botany, biochemistry, and landscape architecture.

*Over a third of the sample indicated that they were interested in developments in their field in Japan but lacked the channels for making use of them.

*Developments outside the university point to a growing need for Japan-related services and information on the campus. State and federal programs call for joint research collaboration, the assessment of critical scientific and technological advances in Japan, and increased knowledge about Japan among businsspeople. Nevertheless, only a handful of faculty--about 10 percent of the sample--had either had materials translated from Japanese or had worked with visiting Japanese scholars.

This report is based primarily upon a survey conducted among the faculty of North Carolina State University. The purposes of the survey were twofold: to assess the demand for Japan-related programs and services on our campus, and to identify individual faculty who should be contacted for specific Japan Center activities. The survey also sought information on extant faculty relations with Japanese institutions that could become partners in more formal relationships.

The NCSU faculty are very interested in cultivating professional relationships with the Japanese: the results of the survey, presented here with supplementary observations, suggest that our university is very receptive to more ties with Japanese institutions and could benefit greatly from them.

I. The Survey Universe and the Sample

North Carolina State University is a Land-Grant university located in Raleigh, the state's capital. There are currently about 22,500 students enrolled, some 3,000 of them in graduate degree programs. The university has traditionally emphasized agricultural and engineering teaching and research coupled with large-scale extension activities. More recently it has developed the fields encompassed in the term "high technology"--computers, biosciences, and materials, among others--as well as departments in the humanities and social sciences.

Until recently, NCSU has not had any special connection with Japan that would have heightened faculty interest in that country. In 1980, the campus was chosen as the location for the North Carolina Japan Center, which began by offering classroom Japanese language instruction and a faculty development program. The faculty program has provided Japanese langudge training and one academic term in Japan to 30 faculty members and staff in 24 departments and programs in the university. With the exception of this recent development, NCSU has not differed from other southeastern Land-Grant schools in its attention to Japan: it has had no Asian Studies program, no sister-school relationship with any Japanese universities, nor any other exchange programs.

The questionnaire form (reproduced in Appendix A) was distributed to the 1,384 rank faculty members of North Carolina State University who were on campus in November of 1982. Since there was no selective sampling, this population equals the "universe" addressed by the study. Although non-rank faculty and professional staff may also have career-related interests in Japan, the survey was restricted to rank faculty for the sake of methodological manageability and simplicity. (Non-rank faculty, though not represented in the current survey, are nonetheless important to the Japan-related programs and activities on the NCSU campus.)

The responses received totaled 819 as of January 31, 1983, a response rate of 59 percent. (Since that time, 10 forms have been returned, but the analysis in this report is confined to the original 819. Subsequent returns do not modify the survey results markedly.) The sample's distribution by rank corresponds almost perfectly with the universe. The response rate does differ somewhat, however, with the respondent's school of affiliation. (Tables 1 and 2 in Appendix B provide sample and universe distributions by academic rank and response rate in percentages by school, respectively.) The average term of employment at NCSU for respondents was about 11 years, and half of the respondents had been with the university for more than eight years. Newcomers to the university (employed less than one year) made up nine percent of the distribution.

II. Professional Activity-Involving Japan

Those who claimed some form of professional involvement made up 14 percent of the faculty at NCSU (191, or 23 percent of the sample). The number of Japanese research and academic institutions with which our faculty have had some form of professional interaction is impressive. Respondents identified 35 research institutes, 23 national universities, 30 private colleges and universities, and 3 municipal universities. The Japanese universities named most frequently were those having very high prestige: the University of Tokyo (21 faculty members), University of Kyoto (18 faculty members), and Tokyo Institute of Technology (11 faculty members). Tokyo University of Agriculture and Technology, an excellent school, also figured relatively prominently among faculty (9).

Involvement most frequently took the form of correspondence with one or more Japanese colleagues; 169 of our faculty (12 percent of all faculty, and 21 percent of the sample) have held correspondence with a Japanese specialist since coming to N.C. State. This correspondence results from both the initiative of our faculty members and inquiries from the Japanese side. Indeed, the nature of most academic contacts probably stems from greater Japanese initiative, as suggested by an interesting contrast in the data set: over 35 percent of the sample recalled sitting in panels or colloquia with Japanese participants, but only 8 per cent reported attending a professional meeting in Japan. (About 23 percent of the respondents had ever traveled to Japan for any reason.) Their Japanese colleagues were evidently more likely to travel to the meeting place, either in the U.S. or some other location outside of Japan. Similarly, 85 respondents reported working with Japanese scholars visiting NCSU, but those reporting research and/or teaching activity in Japan totaled only 46. There are 44 faculty who have co-authored papers with Japanese colleagues, 32 of them since coming to NCSU.

III. Interest in Japanese Resources

A sizeable percentage of the faculty perceive Japan as a valuable professional resource. In the survey, 245 respondents (30 percent of the sample, 18 per cent of all faculty) gave their Japanese colleagues' research efforts an "excellent" rating. Written comments from the faculty suggest that they do not confer their ratings lightly. Among those who gave Japanese colleagues an "about average" rating, for example, were an associate professor of computer science who wrote, "There are some people at Tokyo [University] who are doing excellent work in my area..." and a professor of materials engineering who wrote, "But in some specialized areas, unquestionably excellent!" As the ratings by school and department show, high regard for Japanese research accomplishments is not confined to a few areas such as computers or industrial engineering; the Japanese have received high marks from departments as diverse as landscape architecture, biochemistry, and botany. (Departmental breakdowns are in Appendix C.)

An even larger number of faculty, 328 (40 percent of the sample and 24 percent of all faculty), indicated that Japan interested them as a research site or data source. The question was posed to distinguish natural phenomena, research facilities, and organizational infrastructures from the products of Japanese specialists. Here, too, a wide variety of specialties were involved. Respondents' written-in comments included strong interests in fields as diverse as pesticide education, the Japanese broadcasting industry, facilities for surgery of the horse, and special education for behaviorally disoriented youth. (Departmental breakdowns appear in Appendix C).

Professional interest is reflected in respondents' use of Japanese sources for their own papers; 386 faculty members (47 percent of the sample, 28 percent of all faculty) recall citing Japanese sources at some point in their careers. For 292 of the 386, their use of Japanese sources took place since coming to NCSU. Reliance on D.H. Hill Library for Japanese resources also reflects widespread interest; almost a third of the respondents (266, or 19 percent of all faculty) reported having sought Japanese publications through the library.

IV. Current Needs and Future Challenges

The faculty survey reveals an impressive level of vitality in Japan-related professional activities, but it points to unmet needs as well. The final question and distribution of responses, reproduced below, reflect the latent demand for Japan-related assistance and resources among our faculty.

Please check the one answer that most closely fits the relationship between Japan and your own professional activities:

		PERCENTAGES	
		SAMPLE	UNIVERSE
1	I have been involved with Japanese resources/colleagues.	22.0	13.0
2	I have an interest in developments in my field in Japan, but have not had the channels for developing them (e.g.'s: introductions to Japanese specialists, funding for Japan-related professional activities, information on Japanese professional literature in English, etc.)	1.3* 32.0	0.8* 18.9
3	I had never been exposed to/presented with the issue of finding resources or developments relevant to my field in Japan.	0.2* 32.5	0.1* 19.2
4	To my knowledge, there are no developments in my field in Japan that would be of interest to me.	0.2* 5.5	0.1* 3.3
5	Other (state on the back of the first page)	6.2** 99.9%	3.7** 59.1%
*	percentage checking two adjacent answers	100.0	59.1
**	includes non-responses	N= 819	1,384

The 275 respondents who indicated that they had a professional interest in Japan but lacked the resources to develop it accounted for nearly one out of five rank faculty on our campus (one-third of the sample). Then, too, the somewhat smaller proportion of all rank faculty who claimed some form of professional involvement (14 percent) included individuals who would like help in maintaining or expanding existing ties. Their desire for further assistance is suggested by the 11 respondents who checked both the first and second answers, as well as by the phone call to the Center from one faculty member (a professor of genetics) who wanted reassurance that he would not be excluded from our programs because he had checked the first response only.

The increased Japanese commercial presence in North Carolina presents opportunities for faculty involvement along with a greater demand for Japan-related professional assistance and information. There were 61 faculty (four percent of all faculty) who have consulted for firms doing business with Japan since coming to NCSU. Our faculty have had direct professional contact with over 20 Japanese corporations, most of them internationally prominent. (A list appears in Appendix D.) These figures will increase in the coming years as Japan's prominence in knowledge-intensive industries grows, and as the state attracts more Japanese high-technology industries. Faculty involvement in Japanese business-related activities, however, is no different than more traditional academic endeavors in one important respect: productivity benefits greatly from the academician's degree of Japan-related sophistication, which in turn depends upon a supportive structure of services and information ranging from translation and publication searches to the identification of important contacts, language lessons, cultural activities, and travel information.

Such support programs, however, will require considerable effort to ensure their success because of the linguistic and cultural crevasses between our two countries. Language differences pose a formidable barrier to increased academic contact and activity. Only 80 faculty had ever had material translated for professional use. The unavailability of reliable, reasonably priced services must be a major factor behind the small number reporting translations, given the high level of faculty interest in Japan. Although some respondents reported that they received a satisfactory flow of information on their field in translation, the majority of additional comments on the forms indicated that translations would be useful but were unavailable. (Only a fraction of Japanese literature is translated into English, including scientific and technical publications; see Gibson and Kunkel 1980; Gillmor and Samuels 1983.) There were 46 respondents who reported ever having studied the Japanese language, and 18 of them were Fellows of the faculty development program initiated by the Japan Center in 1980. (The remaining eight faculty members of the original groups had not returned their survey forms in time to be included in the December 1983 sample.)

One indication of cultural unfamiliarity is the strikingly small number of visiting Japanese scholars, researchers and students on the NCSU campus. In the 1982-83 school year there were only ten visiting scholars, four graduate students, and three undergraduate and special students from Japan. (In the same year there were about 80 visiting scholars and 587 graduate students from other foreign countries.) There were 85 faculty (10 percent of the sample) who had ever worked with a visiting Japanese scholar at NCSU.

V. Comment

Demands for Japan-related resources are currently growing outside the university; state- and national-level policy statements call for Japan-related efforts which should involve NCSU and its Japan Center. Governor Hunt's economic development strategy for the state includes reliance on the Japan Center not only to attain the immediate goal of attracting Japanese investments but to gain a wider awareness and knowledge of Japan's people and culture as well, since "the flow of ideas, like the flow of goods and services and the flow of information, can also benefit our economic growth" (Hunt 1980:19). The federal government, despite the current period of cutbacks, has recently generated programs to increase American business' knowledge of Japan (Department of Education) and to monitor and analyze Japanese research and development in critical high-technology areas (Department of Commerce). The government has also called for increased bilateral research activity in areas of strength for NCSU: toxicology, nuclear physics, the marine environment, and "agricultural and forestry problems" (President's Office of Scientific and Technology Policy; Keyworth 1981:7).

Perhaps the best summary to this report is the additional comment written on a survey form from an associate professor of physics. It reflects both the potentials and problems of increased academic interaction with the Japanese:

> Clearly the Japanese are outstanding in the field of physics, second only to the Germans among other developed [countries].... Japanese students in physics never come to school in the U.S. More advanced scholars do visit and work here--language is a very serious barrier.
>
> I visit and collaborate with Europeans rather than Japanese because of language barriers, but also because it is much less expensive to reach Europe. But probably the basic reason is habit--which is what your organization [the Japan Center] is trying to change.

ACKNOWLEDGMENTS

The Japan Center gratefully acknowledges the help of the following individiduals and their fellow staff members: Dr. Michael Vasu and the staff of the Social Science Research and Instructional Computing Laboratory for computer programming assistance; Ms. Mary Strickland and the Provost's Office staff, which provided a master list of rank faculty; and the 75 department and administrative secretaries who distributed and collected the questionnaire forms in their administrative units.

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NCSU Japan Center Survey of
Faculty Professional Links with Japan

APPENDIX
A

NAME:
SCHOOL:
DEPARTMENT:
RANK:
SOCIAL SECURITY #

How long have you been at NCSU? ___years (If first year, please put "0")

Have you ever been to Japan (tourism/military, etc.)? 1___yes 2___no

Have you ever studied the Japanese language? 1___yes 2___no

In the course of your academic career, have you ever:	*YES,* (before coming to NCSU)	*YES,* (while at NCSU)	*NO*
-had Japanese participants in panels/colloquia in which you have participated?	___	___	___
-attended a professional meeting in Japan?	___	___	___
-cited Japanese sources in any papers or articles?	___	___	___
-consulted for a firm or other private organization having business in Japan?	___	___	___
-advised a Japanese graduate student?	___	___	___
-worked with a visiting Japanese scholar? -if "Yes,", from what Japanese institution(s)? ________________________________	___	___	___
-corresponded with a Japanese colleague or professional organization? -if "Yes," what Japanese institution(s)? ________________________________	___	___	___
-co-authored a paper or article with a Japanese colleague? -if "Yes," from what Japanese institution(s)? ________________________________	___	___	___
-taught or lectured in Japan? -if "Yes," at what Japanese institution(s)? ________________________________	___	___	___
-conducted research in Japan? -if "Yes," at what Japanese institution(s)? ________________________________	___	___	___

How would you rate the research conducted by Japanese specialists in your field?

1___excellent
2___about average
3___substandard
4___no opinion

How do you regard Japan as a data source or as a research site for your area of specialization?

1___many potential topics and phenomena of interest
2___perhaps a few potential topics and phenomena of interest
3___nothing of interest that has come to light/not relevant to my field
4___no opinion

Have you ever attempted to find a Japanese publication at (or via) the NCSU library?

1___yes
2___no

Have you ever had material in Japanese translated for you for professional purposes?

1___yes
2___no

Please check the one answer that most closely fits the relationship between Japan and your own professional activities:

1___ I have been involved with Japanese resources/colleagues.

2___ I have an interest in developments in my field in Japan, but have not had the channels for developing them (e.g.'s: introductions to Japanese specialists, funding for Japan-related professional activities, information on Japanese professional literature in English, etc.).

3___ I had never been exposed to/presented with the issue of finding resources or developments relevant to my field in Japan.

4___ To my knowledge, there are no developments in my field in Japan that would be of interest to me.

5___ Other (state on the back of the first page)

** Please feel free to write any additional comments on the back of page 1 **

APPENDIX B

TABLE 1. Percentage Distribution of Rank Faculty and Survey Respondents, 1982 NCSU Japan Survey

Rank	Universe	Sample
Lecturer	7.7	5.0
Instructor	1.4	1.2
Ass't. Prof.	24.4	25.8
Assoc. Prof.	26.4	26.4
Professor	38.0	38.7
Named Professor	2.2	2.9
Total	100.1* (N=1,384)	100.0 (N=819)

(*total exceeds 100 due to rounding)

TABLE 2. Number of Responses to 1982 NCSU Japan Survey, by School

School	Universe(N)	Sample(N)	Percent
Agriculture and Life Sciences	405	264	65.2%
Design	38	19	50.0*
Education	66	42	63.6*
Engineering	149	73	49.0*
Forest Resources	58	39	67.2*
Humanities and Social Sciences	336	173	51.5
Physical and Mathematical Sciences	215	123	57.2
Textiles	41	28	68.3*
Veterinary Medicine	58	45	77.6*
Other (Admin.)	18	13	72.2*
Total	1,384	819	59.2%

(*based on fewer than 100 cases)

APPENDIX C

TABLE 3. Breakdown of NCSU Faculty Evaluations of Japanese Colleagues' Research by School and Department: Means, with Response Ratio

Evaluation: 4 = excellent 3 = about average 2 = substandard
Response: 1 = gave rating 0 = "no opinion"/no answer

School/Department	Respondent Evaluation	Response Ratio	N1/N2
I. Agriculture and Life Sciences	3.47	0.64	169/264
1. Adult and Community College Education	3.00	0.33	3/9
2. Agricultural Communications	3.00	0.20	1/5
3. Animal Science	2.91	0.41	11/27
4. Biological and Agricultural Engineering	3.17	0.24	6/25
5. Botany	4.00	0.78	7/9
6. Crop Science	3.59	0.71	17/24
7. Entomology	3.57	0.84	21/25
8. Extension Home Economics	4.00	0.20	2/10
9. Food Science	3.50	0.80	16/20
10. Genetics	3.73	1.00	11/11
11. Horticulture	3.53	0.70	19/27
12. Microbiology	3.00	1.00	2/2
13. Plant Pathology	3.54	0.86	12/14
14. Poultry Science	3.50	0.86	12/14
15. Soil Science	3.39	0.78	18/23
16. Zoology	3.27	0.85	11/13
17. 4H & Youth Development	-	0.00	0/6
II. Design	3.40	0.50	10/20
1. Architecture	2.75	0.40	4/10
2. Landscape Architecture	4.00	1.00	1/1
3. "Other" (Studio)	3.75	0.50	4/8
4. Product Design	4.00	1.00	1/1
III. Education	3.00	0.07	3/42
1. Adult & Community College Education	-	0.00	0/1
2. Curriculum & Instruction	3.00	0.13	1/8
3. Counselor Education	-	0.00	0/3
4. Educational Leadership & Program Evaluation	-	0.00	0/5
5. Mathematics & Science Education	-	0.00	0/3
6. Occupational Education	-	0.00	0/11
7. Office of the Dean	-	0.00	0/1
8. Psychology	3.00	0.20	2/10

School/Department	Respondent Evaluation	Response Ratio	N1/N2
IV. Engineering	3.68	0.82	59/73
1. Chemical Engineering	3.75	1.00	8/8
2. Civil Engineering	3.80	0.68	15/22
3. Electrical Engineering	3.75	0.89	8/9
4. Engineering Student Services	4.00	1.00	1/1
5. Industrial Engineering	3.67	0.60	3/5
6. Materials Engineering	3.80	0.91	10/11
7. Mechanical Engineering	3.56	0.82	9/11
8. Nuclear Engineering	3.00	1.00	5/5
V. Forest Resources	3.48	0.54	21/39
1. Forestry	3.45	0.58	11/19
2. Forestry Extension	-	0.00	0/1
3. Recreational Resources Admin.	-	0.00	0/8
4. Wood & Paper Science	3.50	0.91	10/11
VI. Humanities & Social Sciences	3.04	0.35	60/173
1. Economics & Business	3.00	0.46	25/54
2. English	2.67	0.43	9/21
3. Foreign Languages & Literatures	3.25	0.31	4/13
4. History	2.83	0.40	6/15
5. Philosophy & Religion	3.00	0.14	1/7
6. Physical Education	2.50	0.13	2/16
7. Political Science & Public Administration	3.25	0.17	2/12
8. Sociology & Anthropology	3.50	0.34	8/24
9. Speech-Communication	3.67	0.27	3/11
VII. Physical & Mathematical Sciences	3.59	0.74	91/123
1. Biochemistry	4.00	0.50	3/6
2. Chemistry	3.76	0.81	17/21
3. Computer Science	3.38	0.80	8/10
4. Marine, Earth & Atmospheric Sciences	3.61	0.9	18/20
5. Mathematics	3.47	0.63	19/30
6. Physics	3.50	0.82	14/17
7. Statistics	3.67	0.63	12/19

School/Department	Respondent Evaluation	Response Ratio	N1/N2
VIII. Textiles	3.59	0.79	22/28
1. Office of the Dean	4.00	1.0	1/1
2. Textile Chemistry	3.75	0.73	8/11
3. Textile Extension	3.50	1.0	2/2
4. Textile Materials & Management	3.45	0.79	11/14
IX. Veterinary Medicine	3.55	0.73	33/45
1. Anatomy, Physiological Sciences & Radiology	3.50	0.67	10/15
2. Companion Animal & Special Species Medicine	3.33	0.75	6/8
3. Food Animal & Equine Medicine	3.44	0.69	9/13
4. Microbiology, Pathology & Parasitology	3.88	0.89	8/9

NOTES: N1 represents the number in the school or department providing an answer other than "No Opinion;" N2 represents the number of survey respondents in the school or department.

Four departments (Agricultural Extension, Computer Center, Industrial Extension Service, and North Carolina Sea Grant) have not responded to the survey. The following administrative units were excluded from the tables in this appendix: Chancellor's Office, the Graduate School, Office of the Provost, Student Affairs, University Extension, University Research and University Studies.

TABLE 4. Breakdown of NCSU Faculty Evaluations of Japan as a Source of Data or as a Research Site, by School and Department: Means, with Response Ratio

Evaluation:
4 = Much of Interest
3 = Perhaps Some Items of Interest
2 = Nothing of Interest

Response:
1 = Respondent Gave Rating
0 = "No Opinion"/No Answer

School/Department	Respondent Evaluation	Response Ratio	N1/N2
I. Agriculture and Life Sciences	3.34	0.83	219/264
1. Adult & Community College Education	2.86	0.78	7/9
2. Agricultural Communications	3.50	0.40	2/5
3. Animal Science	2.95	0.74	20/27
4. Biological & Agricultural Engineering	2.82	0.68	17/25
5. Botany	3.75	0.89	8/9
6. Crop Science	3.36	0.92	22/24
7. Entomology	3.41	0.88	22/25
8. Extension Home Economics	3.83	0.60	6/10
9. Food Science	3.78	0.90	18/20
10. Genetics	3.64	1.00	11/11
11. Horticulture	3.50	0.89	24/27
12. Microbiology	3.00	1.00	2/2
13. Plant Pathology	3.64	1.00	14/14
14. Poultry Science	3.42	0.86	12/14
15. Soil Science	3.10	0.96	22/23
16. Zoology	3.28	0.85	11/13
17. 4H & Youth Development	2.00	0.17	1/6
II. Design	3.65	0.85	17/20
1. Architecture	3.50	0.80	8/10
2. Landscape Architecture	4.00	1.00	1/1
3. "Other" (Studio)	3.75	1.00	8/8
4. Product Design	-	0	0/1
III. Education	3.32	0.67	28/42
1. Adult & Community College Education	4.00	1.00	1/1

School/Department	Respondent Evaluation	Response Ratio	N1/N2
2. Curriculum & Instruction	3.14	0.88	7/8
3. Counselor Education	3.00	0.33	1/3
4. Educational Leadership & Program Evaluation	3.75	0.80	4/5
5. Mathematics & Science Education	3.00	1.00	3/3
6. Occupational Education	3.57	0.64	7/11
7. Office of the Dean	-	0	0/1
8. Psychology	3.00	0.50	5/10
IV. Engineering	3.80	0.90	65/72
1. Chemical Engineering	3.88	1.00	8/8
2. Civil Engineering	3.83	0.82	18/22
3. Electrical Engineering	3.88	0.89	8/9
4. Engineering Student Services	3.00	1.00	1/1
5. Industrial Engineering	4.00	1.00	5/5
6. Materials Engineering	3.91	1.00	11/11
7. Mechanical Engineering	3.67	0.82	9/11
8. Nuclear Engineering	3.40	1.00	5/5
V. Forest Resources	3.28	0.92	36/39
1. Forestry	3.13	0.84	16/19
2. Forestry Extension	2.00	1.00	1/1
3. Recreational Resources Admin.	3.63	1.00	8/8
4. Wood & Paper Science	3.36	1.00	11/11
VI. Humanities & Social Sciences	3.10	0.70	121/173
1. Economics & Business	3.07	0.65	35/54
2. English	2.60	0.71	15/21
3. Foreign Languages & Literatures	3.17	0.92	12/13
4. History	2.77	0.87	13/15
5. Philosophy & Religion	2.57	1.00	7/7
6. Physical Education	3.67	0.38	6/16
7. Political Science & Public Administration	3.29	0.58	7/12
8. Sociology & Anthropology	3.53	0.71	17/24
9. Speech-Communication	3.56	0.88	9/11

School/Department	Respondent Evaluation	Response Ratio	N1/N2
VII. Physical & Mathematical Sciences	3.48	0.77	95/123
1. Biochemistry	3.67	1.00	6/6
2. Chemistry	3.42	0.90	19/21
3. Computer Science	3.57	0.70	7/10
4. Marine, Earth & Atmospheric Sciences	3.58	0.95	19/20
5. Mathematics	3.44	0.60	18/30
6. Physics	3.43	0.82	14/17
7. Statistics	3.42	0.63	12/19
VIII. Textiles	3.80	0.89	25/28
1. Office of the Dean	4.00	1.00	1/1
2. Textile Chemistry	3.63	0.73	8/11
3. Textile Extension	4.00	1.00	2/2
4. Textile Materials & Management	3.86	1.00	14/14
IX. Veterinary Medicine	3.42	0.87	39/45
1. Anatomy, Physiological Sciences & Radiology	3.14	0.93	14/15
2. Companion Animal & Special Species Medicine	3.64	0.88	7/8
3. Food Animal & Equine Medicine	3.60	0.77	10/13
4. Microbiology, Pathology & Parasitology	3.50	0.89	8/9

NOTES: See Table 3.

APPENDIX D

Japanese Corporations with Which NCSU Faculty Have Had Professional Contact

Ajinomoto

Asahi Chemical Industries

Kibun Products

Kurashiki Rayon

Matsushita Electrical Industries

Mitsubishi Heavy Industries

Mitsui Toatsu Chemical Industries

NGK

Nippon Electric (NEC)

Nippon IBM

Nippon Soda Chemical Company

Nippon Telephone & Telegraph

Otsu Equipment Company

Sakata Seed Company

Shinmei Chikusan Company

Shokuraku Asano Company

Showa Denko Chemical Company

Snow Brand Milk Products

Takii Seed Company

Tokyo Gas

Tokyo Kogyo Limited

NOTE: Since this listing is based upon responses to questions dealing with institutional affiliations, it considerably underrepresents the range of faculty contacts with Japanese firms. (Faculty were not asked to name consulting clients.)

Dr. COLEMAN. Now I would like to also mention that someone had said that one good idea might be to strengthen language requirements. I would like to take exception to that statement because in our experience, we have seen that students who take language because they are forced to are not going to be necessarily your best students. That's not the way to motivate students. And, indeed, if there's a language requirement, chances are pretty good that a lot of students will try enrolling in what they think is the easiest language possible. And as you gentlemen know, that's not Japanese.

Another thing, too, is that I suggest Japanese language education go to our students; they are our best investment. I am very proud of what we've done for our faculty, and I am very proud of how they have responded to the challenge. But in trying to teach fully formed professionals the Japanese language, we see that the obstacles are huge. They already have their career commitments. It's very difficult for them to set aside the time and energy to learn Japanese. Students, I believe, are where it's at for this kind of investment.

We agree with the major conclusion of the 1983 MIT-sponsored workshop that for our Japanese scientific and technical needs for a long-term solution, we have got to train a generation of technical and scientific specialists with a professional command of the language. And there are some good reasons for that. For one thing, as Professor Bartholomew pointed out yesterday, engineers, in particular, rely on oral communication to a very high extent to get the information they need. And this trend, if anything, is going to grow stronger because in the nature of technology, as technologies becomes more complex they become more difficult to price, and this means that the kinds of arrangements that are worked out between Japanese and American companies are going to have to be more and more unorthodox: you can't depend on traditional patented arrangements and licensing arrangements. What we see now are arrangements that involve information exchanges, visitation rights. And for our corporate engineers and other technical specialists to work out these agreements with the Japanese on equal footing, they must have a command of the Japanese language.

Then, too, I would also point to the greater self-sufficiency of the Japanese, not only technically, but politically and militarily. With this trend it is inevitable that they will feel less and less inclined to accommodate us in English for our scientific and technical needs.

Now, on to our problems. We need the means to involve our students in Japanese language study earlier in their careers. Many of our best students, over half of them, are ending their Japanese language education because they are graduating before we have a chance to give them a basic command of the language that they can build upon in their careers.

Another problem concerns our graduate students. We have graduate students studying Japanese but they need incentives as well, including awards for doing research in Japan.

I would like to submit to this committee the case of Mr. Joe Doolan. Mr. Joe Doolan is a graduate student, a Ph.D. student in textile chemistry at North Carolina State University. He's been studying Japanese this last year; his adviser has an excellent, collaborative relationship with Tokyo Institute of Technology, and they have invited Mr. Doolan over there to conduct research. Mr. Doolan may not go, however, because there is no category of funding that addresses this particular need.

In addition, his doctoral curriculum program does not make the room for language study. So right now he is forced to reconsider whether he continues the language or not.

And myself, I have a Ph.D. in anthropology from Columbia University. And while I was at Columbia, they gave me a professional command of the Japanese language that I used in my own research. The classroom work that I did for that degree was done under a National Defense Foreign Language Fellowship, and I daresay I couldn't have made it through the program without that kind of help.

I think that assistance of that order to people like Mr. Doolan is entirely appropriate.

This committee has asked about the role that industry can take, and I would like to offer the committee some suggestions there as well.

We look to industry to place our interns as they come along. I think more basic than that, is the obligation of industry to begin to define and articulate the career roles that await an individual in a scientific or technical speciality, who has made the commitment to study Japanese. If you talk about something that's going to help motivate our best, our elite students, that's it.

I might also note that it would be entirely appropriate for industry to endow chairs for those faculty members who have demonstrated an enrichment of their particular fields though successful collaboration with Japanese colleagues.

I think that the Japanese scientific and technical information needs that this committee has been discussing are symptomatic of an overall situation in the United States that needs long term and multifaceted efforts. And when I say multifaceted, I will offer you a brief example of what I'm talking about.

Right now at North Carolina State we are looking into strategies for encouraging more Japanese researchers to come and take part in our graduate programs and in our research programs in science and technology. Why? Well, for one thing, they make excellent research partners. They also make excellent alumni. Some of them, while they are here, are going to provide local translating expertise. A faculty member can learn from them while they are here and we can cultivate among our faculty knowledge of what Dr. Westney called the invisible college; that valuable skill of knowing who has the material that's worth translating; that all important issue of discriminating among the whole wealth of materials where we get the most bang for the buck when we do decide to translate.

Then, too, with these connections that we are going to make, this feeds back into the whole issue of promoting Japanese language study because these colleagues will be a great help in placing students in exchange programs.

Now, should the Government come to feel as we do toward the potential of university-based centers for these kinds of activities, I have a few suggestions that I hope will come in handy.

First, these centers should be located in those universities that have a good track record of cooperative activity with industry in terms of cooperative programs for research and development. These are the universities that are sensitive to industry needs. They are the universities that have developed the channels for meeting those needs while preserving academic goals. They can also expedite the flow of Japanese scientific and technical information to industries of all sizes.

Then, too, these channels can be relied upon so that you aren't creating redundant administrative structures.

One other point that I think's very important that my colleagues touched on yesterday: select schools that demonstrate a willingness and a flexibility to create Japan-related courses for students majoring in sciences or engineering. The well-established Japan centers in this country are not necessarily your best candidates because they have been designed and they are structured to meet the needs of students in the humanities and to some extent the social sciences.

These students can afford to spend as much as half of their classroom time studying the language, and that is the kind of demand that's just not appropriate to make of students in the sciences and engineering. If you don't take care to make a program that recognizes their curriculum needs, you are going to lose them.

I would say the same thing, too, about Japan-related courses that aren't language courses, like history and social sciences; create courses that respond to the interest and needs of these scientific and technical specialists when they begin their careers.

Well, the suggestions that I've made I fear might sound a little ambitious to the members of this committee, but I, myself, have made them as a person who works every day with these people; and I've found them to be very ambitious, and very highly motivated.

I feel, and I'm sure my colleagues yesterday feel the same way, a little bit like Winston Churchill when he said, "Give us the tools, we'll do the job."

I'm very happy to have this chance to have said these things to you. Thank you.

[The prepared statement of Dr. Coleman follows:]

Testimony of Samuel Coleman, Ph.D.
Associate Director for Research and Program Development

North Carolina Japan Center
North Carolina State University

March 7, 1984

Subcommittee on
Science, Research and Technology

I am honored and gratified by the invitation to testify that this subcommittee of the Committee on Science and Technology has extended to me. I wish to commend the Committee for its efforts to raise public awareness of our country's need for organizational mechanisms that can make Japanese scientific and technical information (JSTI) available.

After introducing the North Carolina Japan Center and my role there, I would like to briefly describe our JSTI-related needs and then propose some programmatic measures that should help meet the objectives of this subcommittee.

The Japan Center was established at North Carolina State University in 1980 as part of a series of investments designed to foster cooperation among industry, universities, and the state's government in developing the North Carolina economy. Other recent state-sponsored developments with the same objective include the Microelectronics Center of North Carolina and the North Carolina Biotechnology Center. The Japan Center was established primarily to make the state more attractive to Japanese investment, but it was given a broad mandate to conduct Japan-related activities for the benefit of the state. Its location at North Carolina State University, a land-grant institution, reflects the planners' desire to draw upon and complement the university's greatest strengths: science, technology, and public service through extension activities.

North Carolina State University, with Duke University and the University of North Carolina at Chapel Hill, forms the "Research Triangle" area of North Carolina. NCSU is the most active university partner with companies located in the Research Triangle Park, a 6,000-acre tract in the center of the triangle that contains some 45 research-oriented firms and agencies with a workforce of about 20,000.

Since mid-1982, when I joined the Japan Center, I have been organizing and administering academic programs that relate in large part to scientific, technical and commercial activities that involve Japan. I am a Japan specialist by training, with a Ph.D. in Anthropology and an East Asian Institute Certificate, both from Columbia University. I earned them with the indispensable help of three years of National Defense Foreign Language fellowships.

The Center has emphasized Japanese language learning since its very inception; the first academic post filled was that of language instructor, and the first major program involved Japanese language instruction and a semester in Japan for a handpicked group of NCSU faculty members from a variety of disciplines. Of 30 faculty who have benefited from the program, 10 are in scientific or engineering fields. As of fall, 1983, there were 72 students enrolled in our Japanese language classes, making ours the largest Japanese language program in the Southeastern United States. What makes our language program truly unique, however, is the composition of these classes: about two thirds of our regularly enrolled students are majoring in the sciences and engineering.

The Japan Center has just begun a program which places engineering and science students in internships in Japanese firms for one semester. One graduate student in Electrical and Computer Engineering and a recent graduate in Computer Science (both natives of North Carolina) are currently working at Japan IBM's Fujisawa Development Laboratories. The Center has also been providing a ten-week Japanese language and culture orientation for engineers at the IBM facility in the Triangle.

In addition, the Japan Center acts as a clearinghouse for information relating to translating and interpreting, academic exchanges, and Japanese business practices.

One problem that the Japan Center has not encountered is an indifference among our faculty to the accomplishments of their Japanese colleagues. In a 1982 survey of our faculty (819 responses, a return rate of 59 percent), Japanese research received excellent evaluations, not only in seven of the eight departments comprising our School of Engineering, but in a wide variety of departments in other scientific and technical schools as well, including botany, biochemistry, plant pathology, textile chemistry, marine, earth and atmoshperic sciences, and microbiology.

Our faculty in the sciences and engineering--particularly those who have entered our language program--also support our efforts to provide Japanese language training to their students. We agree with the conclusion of the January 1983 M.I.T. workshop on JSTI that a long-term solution to our information needs must involve the creation of a new generation of scientific and technical specialists with Japanese language expertise (Gillmor and Samuels' March 1983 report, Japanese Scientific and Technical Information in the United States, reproduced by NTIS).

There are several sound reasons to advocate Japanese language training for future engineers and scientists. Japanese and American corporations are relying less and less on the traditional contractual forms of technology transfer, patents and licenses, and are opting instead for nontraditonal arrangements such as information exchanges and visitation rights. (This trend results in large part from the complexity of the technologies involved and the dificulty of pricing them.) In order to participate in these new arrangements on an equal footing, our companies need technical specialists with a good command of the Japanese language. Since an ever larger part of information transfer is taking place through face-to-face communication, these individuals would be much more effective when interacting with Japanese colleagues and clients. Their ability to do their own translating would greatly expedite the assimilation of printed JSTI also.

Perhaps of equal importance, we need greater numbers of technical and scientific specialists with ability in Japanese because the Japanese themselves are going to be less inclined to provide information in English as their technical self-sufficiency grows and as they achieve more political and military independence from the United States.

Our students in the sciences have begun to demonstrate an interest in learning Japanese, as evidenced by their majority presence in our language classes. But we need to reward their interest. We also need to bring these students into our language classes early enough in their college careers to give them a basic level of proficiency before they earn their degrees and leave the university. Currently, too many of our most promising first- and second-year Japanese language students discontinue their language study due to graduation. I should also note here that our best language-teaching investment will be in students, not established professionals: I am extremely proud of our faculty who have made the commitment to master the Japanese language, but our efforts to teach them have also revealed the considerable difficulties of adding such a time- and energy-consuming enterprise to their already demanding full-time careers. We have also encountered these difficulties in our courses for corporate professionals.

We need funding support for summer intensive language courses with scholarship support, so that our students in the sciences and engineering can integrate Japanese language study with their demanding course loads. We also need fellowships research awards to encourage and support our graduate students. I offer this subcommittee the case of Mr. Joseph Doolan, a Ph.D. student in Textile Chemistry at NCSU. His advisor has had an excellent collaborative relationship with colleagues at the Tokyo Institute of Technology, and is ready to send Mr. Doolan there for his dissertation research. There are no funding sources that address such research activity in Japan, however. Mr. Doolan began Japanese language study last year, but the uncertainty of his prospects for getting to Japan, coupled with a doctoral program timetable that makes no room for language study, have forced him to reconsider continuing his Japanese language course work.

Although I am focusing on Japanese language instruction as our country's most important long-range goal, there are a variety of university-based programs that would benefit our scientists and engineers who have no knowledge of Japanese, and these programs would also augment the efforts of our language programs. As one example, we are currently examining ways to encourage researchers and graduate students from Japanese industry and academia to come to our campus. These long-term visitors will provide many learning opportunities for our faculty. Through these associations, our faculty will become more adept at identifying and selecting those materials in Japanese that are most worth translating. And many of the Japanese visitors will provide local technical translating skills as well. They will also become valuable contacts for placing students in internships and academic exchanges, which in turn provide valuable means for the promotion of Japanese language study.

Multi-faceted programs at university-based centers of Japan-United States scientific and technical cooperation offer the most productive location for our JSTI-related efforts because, as the above example illustrates, such programs create mutually reinforcing information networks. And the university centers that could best pass along the fruits of such networks to American industry would be those that have already developed a variety of cooperative relationships with business. Such schools are attuned to the needs of their corporate partners and have developed the most effective channels for meeting them while preserving academic goals. In addition, these universities are now devising practical solutions to the ever-present problems of honoring proprietary information while pursuing open exchange of information, and such solutions might well provide guidelines for projects that involve the Japanese private sector.

In response to the subcommittee's request for suggestions regarding constructive roles for government and industry, I would like to propose that the federal government provide funding support for scholarships and fellowships to students in the sciences and engineering who commit thenselves to the study of the Japanese language. Looking back at my own student career, I doubt if I could have persevered in my study of the Japanese language at Columbia University were it not for a federally supported foreign language fellowship program which enabled me to get a Ph.D. degree. We now need such a program for students like Mr. Doolan.

Industrial concerns can and should play a complementary role that begins with recognizing the value of technical specialists with a professional grasp of Japan's language coupled with some knowledge of the country's society and culture. We depend on the industrial community to create internships for our students that involve work in Japan. More importantly, we depend upon industry to define career opportunities for these students once they graduate. It would aslo be entirely appropriate for American corporations to fund academic chairs that would honor and reward those scholars in the sciences and engineering who have demonstrated outstanding ability to collaborate effectively with Japanese colleagues to the benefit of their disciplines.

Federal support could take place in the context of designated regional university-based centers, and could also include support of programs for collecting and translating written JSTI. I have suggested that such centers of activity be located at those universities that have demonstrated a variety of viable cooperative relationships with industry, in order to expedite the flow of JSTI to the private sector. I would like to add another important criterion for selecting participating universities. The most effective university partners for the efforts that I have described are schools that can demonstrate the willingness and flexibility to design Japan-related course offerings to meet the specific needs of students in the sciences and technology. Long-established Japan programs at American universities do not automatically qualify: they are geared to the production of Japan specialists in the humanities and social sciences. Students in those programs can afford to devote up to half of their course work to language study, but such involvement poses an unreasonable demand for students in the sciences and engineering. To be successful, any attempt to provide the latter group with knowledge of the Japanese language and society must be coordinated with the curriculum demands of those students' majors. The non-language Japan courses for those students should consist of offerings in the social sciences and history that address their interests and knowledge needs also.

I hope that I have not disappointed the members of this subcommittee becasue I have emphasized language programs and have not focused on projects like centralized bibliographic and translating clearinghouses for JSTI. From my own university-based position, however, I see America's current JSTI needs as a systemic challenge that requires a multi-faceted, coordinated solution in order to reap substantial long-term benefits.

I thank this subcommittee for the opportunity to discuss these issues, and I welcome any questions or requests for further information.

Biographical Sketch

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After enrolling in 1964 as an undergraduate at the Santa Barbara campus of the University of California, Coleman specialized in cultural anthropology and Japan studies. He graduated in 1968 with highest honors and membership in Phi Beta Kappa. He then entered graduate school at Columbia University as a Fellow of the Faculty in the Department of Anthropology. His full-time graduate study in residence was funded by the National Defense Foreign Language Program. Between 1974 and 1977 Coleman conducted dissertation research in Japan on the subject of birth control, under an award from the Social Science Research Council. At that time he was affiliated with the University of Tokyo Department of Sociology as a Visiting Foreign Researcher. He received his Ph.D. in Anthropology from Columbia in 1978.

After receiving his doctorate, Coleman joined the Johns Hopkins University Population Information Program as a Staff Research Associate, analyzing population and public health issues in developing countries. In 1979 he received a post-doctoral fellowship in population studies at the Carolina Population Center at the University of North Carolina (Chapel Hill) under which he reanalyzed his dissertation research data and reported his findings in professional publications. These writings include his book, Family Planning in Japanese Society, published by Princeton University Press in 1983.

In 1982 Coleman joined the North Carolina Japan Center at North Carolina State University, where he assumed responsibility for organizing and administering Japan-related academic programs involving business and science.

Samuel Coleman is married to Hiroko Kataoka, Ph.D., who is Assistant Professor of Japanese in the Department of Foreign Languages and Literatures, North Carolina State University.

Mr. **Walgren**. Thank you very much, Dr. Coleman.

That testimony is well received and in the Congress there are beginning to be glimmerings of recognition of the basic language abilities that we need if we are to survive economically in an international world. But those suggestions are only now beginning to attract the attention that they should have and so your testimony is right on that point and very well taken.

Let me turn to Mr. Johnson and then we will finish the panel and come back for some discussion.

Mr. **Johnson**. I am delighted to be here today to talk to you on this subject, and I'm here in kind of two roles. First of all, I am the president of the Magnetics Society, one of the 30-odd societies that make up the Institute of Electrical & Electronics Engineers. This institute is the world's largest organization engineering organization, with roughly a quarter of a million people worldwide, 200,000 in the United States, and four-fifths of which are in industry.

Second, I am the cofounder and chairman of a high-technology enterprise that has taken a Japanese-developed technology, brought it back to the United States, and is now commercializing it.

To respond to one of the comments earlier, it has been our observation that the Japanese are very creative in basic research and quite capable of commercializing new technologies. In fact, our biggest competitors are such well-known names as Sony and Toshiba. And we are the only U.S. company developing this technology, and if anyone is interested I can talk more about that later.

At any rate, in the last 20 years, the Japanese have obviously moved into—have moved into second place technically. And while I have been associated with the Magnetics Society, we have seen some disturbing trends. The number of Japanese articles published in the Transactions on Magnetics of the IEEE and papers presented at the—our international conference held every year, have been monotonically increasing until last year, for the first time, Japanese papers became the majority number of papers.

Also, another disturbing trend, we have noticed as the Japanese are developing this technology, and they are now perhaps equal to the United States, more and more of the original research work has been published in the Japanese journals, especially those proceedings of technical conferences which are held in Japan on, for example, data storage, magnetic data storage.

We have been very concerned about the fact that the Japanese are now publishing first in their own journals and, second, in the journals in the United States.

The U.S. shipments of magnetically based products is a multibillion dollar a year industry and the magnetic recording alone is about $4 billion a year; and we are in imminent danger of losing a good share of this market to Japanese manufacturers.

The Magnetics Society has this year decided the situation was intolerable and has been making arrangements to translate the two journals on magnetics into English, and publishing them on a weekly—I'm sorry, on a monthly basis, as a Translation Journal on Magnetics. We are taking both the journal of the Magnetics Society of Japan and the Magnetics Journal of the Institute of Electronics

& Communcations Engineers of Japan, plus the special conference editions, and translating them.

This has been a very tough thing to organize. We are doing it basically using Magnetics Society funds simply because we have a little extra money and it is so vital.

It is—it would be my recommendation that some organization within the Government provide a little seed money to get this translation started. About three decades ago, at the time of Sputnik, the National Science Foundation provided seed money to translate the Russian physics journals, and it seems to me that this might be considered again.

I think after these translations start, the subscriptions could probably support further translations.

We at Vertimag, had relied on two sources for own internal use. One is the translation of articles that appear to be of interest to us, translated by Japanese students in the engineering department at the University of Minnesota, these are very unsatisfactory simply because of the fact that English is not their basic language and massive editing is required.

Second, we have relied upon our colleagues in Japan, and we have many contacts in Japan, to point out and translate those articles that they think might be of interest to us. The problem with that is, I'm sure we miss a large number of articles.

The Magnetics Society has contracted—or is in the process, I should say, of contracting—with a translation service in Tokyo that is operated by people whose basic language is English, and who are technically knowledgeable. We expect to have this in operation in order to start this translation in January 1985.

The Magnetics Society is only one of 30-odd societies that are part of the IEEE, and all of these societies have Japanese-translation problems in varying degrees. Certainly, the Computer Society and those in the semiconductor industry are probably equally affected by inability to access Japanese technical literature.

One last comment I'd like to make with regard to the comment in Dr. Coleman's remarks about the University of Minnesota. My colleague, one of the cofounders of the company, runs the magnetics research center at the university. He has had, over the last 10 years, a number of graduate students, 90 percent of whom have been Japanese.

These students had been totally supported by their companies, and sent over here for a number of years, to study in his laboratory.

We had located in basically the largest area of computer manufacturing in the United States, the Minneapolis/St. Paul area, and yet, 90 percent of the graduate students are from Japan. I think there's a message there.

Thank you.

[The prepared statement of Mr. Johnson follows:]

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STATEMENT ON THE TRANSLATION OF JAPANESE JOURNALS

BY

MR. CLARK E. JOHNSON, JR.

on behalf of the

MAGNETICS SOCIETY

of the

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Delivered before the

SCIENCE AND TECHNOLOGY COMMITTEE

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I am delighted to be able to be here today to share with you my views on the translation of Japanese journals. I am appearing here in two roles: first, as President of the Magnetics Society, one of the thirty-odd technical societies that comprise the Institute of Electrical and Electronics Engineers. Second, I am a founder and presently Chairman and Chief Technical Officer of Vertimag Systems Corporation, a Minneapolis-based start-up that is commercializing what is essentially a Japanese technology. As a consequence, I have the opportunity of sharing with you not only the views of the Magnetics Society but also my personal experiences as a high-technology entrepreneur.

The IEEE is the world's largest engineering society, with nearly 250,00 members worldwide, 200,000 of whom live and work in the United States. Approximately 82% of our membership is employed in industry, 8% in academic institutions, and 10% in the various government laboratories and agencies.

In the last twenty years, Japan has moved unquestionably into second place in technology worldwide. Insofar as publications by Japanese researchers are concerned, until very recently, most of their manuscripts were published in English in the American technical literature. As a consequence, American researchers along with those in the rest of the world, had no difficulty in obtaining Japanese research results.

As the level of Japanese magnetics technology has broadened over the past few years, more and more of the Japanese research work is published only in Japanese journals. This is an asymmetric situation, since virtually all Japanese can read English, whereas only a tiny fraction of American researchers can read Japanese. As a consequence, we in the west are being cut off from significant and important research results.

In the United States, magnetically-based products represent a multi-billion dollar industry. In fact, the magnetic recording industry is itself a multi-billion dollar per year industry. We in the United States are in imminent danger of losing both our technological leadership and a large portion of the computer peripheral disk drive business to the Japanese. The Japanese have already taken over virtually all of consumer electronics and a large fraction of semi-conductor manufacturing. They have recently announced a so-called 5th generation computer, whose peripheral data storage is virtually all magnetics.

The Magnetics Society annually sponsors a conference called "The International Conference on Magnetics" or Intermag. The percentage of Japanese papers has been increasing. At the 1983 Intermag Conference held in Philadelphia, the Japanese presented, for the first time, the majority of the papers. Yet this represents only the tip of the iceberg because the large majority of Japanese literature in magnetic recording is now printed in Japanese and is therefore virtually inaccessible to most of us.

The Magnetics Society, with the help of the Publications facilities of the IEEE, plans to institute a program to translate the Japanese journals specifically aimed at magnetics. This amounts to approximately 1,500 pages per year from two Japanese journals and a number of special proceedings of conferences devoted to magnetics.

Procedurally, we will have the articles translated by a Tokyo based translation firm operated by people whose native language is English and who are trained in those areas of technology that are relevant to magnetics. Our hope is to be able to start a translation journal on Japanese magnetics, effective January 1985, and to make the translations available to our members on a subscription basis. We will be the first society of the IEEE to provide such services.

Personally, I feel there are a large number of Japanese journals in various engineering and physics disciplines that merit translation. The Institute of Electronic and Communication Engineers in Japan (IECE) publishes 27 technical periodicals, only one of which is in magnetics.

All of this takes money. While the Magnetics Society, insofar as technical societies go, has sufficient reserves to undertake this endeavor itself, this is not true of most of the other technical organizations that could benefit from Japanese translations.

In order to raise the level of awareness of the importance of the Japanese technical literature and to enhance its distribution and assimilation, we recommend that an appropriate Federal agency provide seed money for a program to help get a translation service started. The National Science Foundation set a precedent several decades ago when it initiated a program to translate Russian physics journals into English. That effort was subsequently picked up by the private sector.

From my own personal experience as a founder and chairman of a high-technology company immersed in magnetics, let me say that lack of easy access to Japanese technical journals has been a severe problem for us. Vertimag Systems retains a local Japanese-speaking engineering student to translate articles of interest to us. These translations often require significant editing. More importantly, we have no easy access to an index of Japanese technical literature. Such an index would go a long way toward allowing us to track Japanese technology, but would not in itself solve the problem.

In conclusion, let me say that Japanese technical literature translation is a vital and urgent matter, and especially a concern to small entrepreneurial technology-based companies. Large companies either have set up with in their own organizations means of accessing Japanese literature or consider that such literature is not relevant to their needs.

It is the small companies, those that will be providing the majority of new jobs in the future, to whom this is such a vital concern.

3/6/84

Mr. Clark E. Johnson, Jr.

Clark Johnson, Jr. was born in Minneapolis, MN on August 3, 1930. He received his B.S.(Magnetism) from the University of Minnesota in 1950, his M.S. in 1961. He held the position of Senior Physicist, Cent.Research Laboratories Minnesota Mining & Manufacturing Co. from 1950-1959; President, Research & Development, Leyghton-Paige Corp. 1959-1961; President, Telostat Corp., 1961-1963; Vice President, Minnetech Laboratories, 1963-1966; Vice President, Engineering, Vibrac Corp. Division, USM Corp., 1967-1972; President, Micro-Communications Corp., 1972-1977; Director, Research & Development, BUCKEYE INT, Inc., 1977-1980. He is presently Chairman of the Board and Chief Technical Officer, Vertimag Systems.

His concurrent positions include: Consulting Physicist, Graham Magnetics, Inc., 1968-1974; Director & Technical Advisor, Trans Data Systems; Finance Committee Chairman-Magnetics Society, 1975; Member, AAAS, Institute of Electrical & Electronics Engineers, Inc.; American Physics Society; Instrument Society Am.; NY Academy of Science, Research: Magnetic theory; magnetic recording and recording materials; fine particle magnetic theory; electromagnetic transducers and devices; electro-optic transducers and devices; new techniques for recording information using magnetic properties of materials.

Mr. WALGREN. Thank you very much, Mr. Johnson, we certainly appreciate those observations.

Mr.—and is it Majcher?

Mr. MAJCHER. Majcher.

I also would like to thank the committee for inviting me to speak before it.

I manage the technical information center for Xerox Corp. in Rochester, N. Y., and being a librarian, I would like to start out with a quote from a journal article to sort of belabor the point that I think's been presented before the committee in the last 2 days.

This is an article by a—Elizabeth Waukie, entitled "Translation Activities in the United States and Future Requirements." And she opens her article, and I quote:

> Notwithstanding articles in the popular press, there exists in the United States today a formidable language barrier that hinders rapid dissemination of foreign scientific and technological information among American scientists. The information explosion, that exponential rise in the worldwide publication rate, generally considered to have begun following the second World War, has been brought vociferously to public attention. Until recently, however, the fact that over 50 percent of this literature originates in languages other than English, has been almost ignored outside the intelligence and other government circles, and most sophisticated groups of literature scientists.
>
> Present and future requirements for translating foreign technical information into English are so vast that only by fully exploiting the combined resources of government, industry, universities, professional societies, commercial and individual translators and linguists, and electronic translating machines, can we hope to control this phase of the 20th century's information problem.

I would like to point out that this was published in 1963. There still exists a significant problem in this area, as you are aware.

According to Mr. Gibson, who will be testifying a little later, less than 20 percent of the scientific and technical information is readily available. Again, belaboring the point, it's primarily a fact of the language barrier that exists, which in turn is—sorry, I can't think of the word.

The point I am trying to make is we do have a significant lack of translating capability. Not only do we lack good Japanese translators; again, the point previously made that good scientific and technical translating capabilities are almost nonexistent. It is extraordinarily difficult to find anyone to provide this service.

The secondary problem is the internal lack of a centralized and formal information system within Japan itself. They rely much more heavily on the invisible college network than the published proceedings of their conferences and research.

I personally feel that the lack of this information makes a librarian's job and information manager's job, and ultimately the job of a scientist or a researcher extremely difficult.

It was pointed out, or asked earlier, about the not-invented-here syndrome. Its been my experience that any researcher or scientist is more than willing to build on the work of others. When the work of others, particularly our Japanese competition, is not readily available, he has no shoulders to stand on, so to speak.

I was most happy to hear Dr. Coleman's comment requesting support of proven universities. And I would also encourage an equivalent look at industries and small businesses that are providing very cost effective access to the Japanese literature in selected areas.

However, they are only touching a very small tip of that iceberg.

I would also encourage this committee to consider utilizing the existing resources within the information community itself. A National Science Foundation grant to the John Crerar Library, for example, to utilize their existing information on translations by automating and making the—that information readily accessible, the on-line data base would be a excellent step and the initial control and dissemination of that information.

Thank you.

[The prepared statement of Mr. Majcher follows:]

THE AVAILABILITY OF JAPANESE INFORMATION

The availability of scientific and technical information from Japan in the United States is severely limited. In fact, less than 20% of the Japanese scientific and technical literature is even covered by Western indexes and abstracts.[1] Mr. Robert Gibson and Mrs. Barbara Kunkel, of General Motors, have done an outstanding job in analyzing the availability problem in their book *Japanese Scientific and Technical Literature - A Subject Guide*. This lack of availability has been obvious to every librarian and information manager who attempts to provide such information to their clients.

There are a number of reasons for the inaccessibility of this information. The primary problem being the language barrier itself.

Japanese is a complex language, utilizing a combination of orthographies, with syntactic structures significantly different from English. Consequently, there exists a deficiency of trained translators in general, and in particular, a significant lack of translators with the technical background to adequately interpret scientific information. This, in turn, has resulted in high costs to obtain such translations. For example, we currently pay over one dollar per line, or over $7,500 per year, to translate just one Japanese journal in the area of electrophotography. The cost of a secondary service providing limited bibliographic information for a small number of journal titles has been quoted at over $500,000 by several abstracting and indexing services. Thus, the language complexity and lack of skilled technical translators results in extremely high costs to obtain Japanese information, costs which clearly surpass the capability of any one corporation or secondary service.

Another problem in the accessibility of Japanese information is the lack of centralized and formal information systems and services within Japan itself. This is particularly evident in the area of technical report literature. However this situation has changed rapidly over the last few years. As a result of a study, "Formation Process of Information Systems and Organization of Scientific Information", conducted between 1976 and 1979, sponsored by the Ministry of Education, Science and Culture, a plan for upgrading the Japan Information Center of Science and Technology was proposed.[2] This is significant in terms of highlighting the efforts by the Japanese in building an extensive information network with regards to scientific and technical literature.

The impact of the lack of availability of Japanese information to the U.S. is significant. While no good estimate of dollar impact is available, the Japanese themselves obviously consider it an area of great importance. As an example, in the area of VLSI, it is estimated that 35% to 40% of the base-line data obtained by Japan came directly from gleanings of information readily accessible in the U.S. public literature. It is also estimated that Japanese companies have deployed over 1,500 software experts in the United States, supported by a collective budget of 25 to 30 million dollars per year in order to provide information supporting their fifth-generation computer efforts.[3]

The Japanese have made a science of market research and technology tracking. As the Japanese begin to establish frontier technology positions in VLSI, robotics, computers, and biotechnology; it becomes more critical to provide mechanisms for the identification, translation, and dissemination of their scientific and technical information to U.S. scientists and researchers

There are a number of solutions to increase the availability of Japanese information. When a similar problem was experienced in the late 50's with Russian technical literature, a joint effort was established between the Special Library Association's Translation Center at John Crerar Library and the Commerce Department's Office of Technical Services to acquire, announce and dessiminate translations from government and private sources. This is an excellent model of cooperative efforts between governmental and private sectors, which should be examined for applicability in the current situation.

Efforts must also be expended to dramatically increase the availability of qualified technical translators, either through education, or utilization of Japanese nationals who are experts in particular technologies within U.S. governmental agencies and business. [4]

In summary, a concerted effort must be put forth by both government and industry to provide timely and cost effective access to a readily available source of translated technical material in technologically critical areas. Substantial investments of time and money will be required to do so. However, the failure to address the widening gap of information availability can only result in increasing technology deficits between the U.S. and Japan.

Michael D. Majcher

ENDNOTES

1 "*Japanese Scientific and Technical Literature - A Subject Guide*" by Robert W. Gibson and Barbara K. Kunkel. 1981

2 "*Scientific Information Systems in Japan*" edited by Hiroshi Inose. 1981

3 *Business Week*, December 14, 1981, p. 5

4 "*U.S. -Japan Technology Exchange Symposium*", Japan-American Society of Washington. 1981

Michael D. Majcher, Manager of Xerox Corporation's Technical Information Center in Webster, NY, directs the activities of the research library, located at the Joseph C. Wilson Center for Technology in Webster. He is also responsible for a Reference/Search Services group, and a Technical Services group, comprised of Acquisitions, Cataloging/Processing, Micrographics, and Database Maintenance sections.

Prior to joining Xerox Corporation, Mr. Majcher was Manager, Micrographics at Calspan Corporation in Buffalo. At Calspan, he was responsible for a wide range of micrographics services and was also involved in the commercial marketing of on-line retrieval systems.

He holds a BS degree in Psychology, as well as an MLS degree from the State University of New York at Buffalo. Mr. Majcher is actively involved in such professional organizations as the Association for Information and Image Management, of which he is founder and past President, Western New York Chapter; the Industrial Technical Information Managers Group, the American Society for Information Science; the Special Libraries Association and the American Library Association. He also serves on the Board of Directors, Copyright Clearance Center, Inc,; the Board of Trustees, Case Western Reserve, School of Information Science and the Board of Advisors, Engineering Information, Inc.

Mr. **Walgren**. Thank you very much, Mr, Majcher.

Let me turn to Mr. Valentine at this point for any thoughts.

Mr. **Valentine**. Thank you, Mr. Chairman.

I would like to ask Dr. Coleman a question or two about this Japan Center which he's involved with.

Doctor, how is that department funded, and is it another department of North Carolina State University or is it something that is like the Institute of Government at Chapel Hill? Could you tell us more about the structure of it and whether your money will come altogether from the State, or some from private——

Dr. **Coleman**. Um-hum.

Mr. **Valentine** [continuing]. Foundations? And, indeed, if you have found any way to tap into this flow of money that comes down from Washington. [Laughter.]

Dr. **Coleman**. Right. We were funded originally by the State government. That's where all of our current operating costs do come from. We are located within the school of humanities and social sciences at State right now.

Currently, a study committee is looking over our position within the university and is considering the issue of where within North Carolina State University would be most appropriate for the Japan Center to be located. We may not always be home in the school of humanities and social sciences.

Indeed, as far as funding from other sources is concerned, our present level of funding just does not cover the kind of programs that we are considering.

I think that both private and Federal sources would be quite appropriate for the programs that we are considering. For example, scholarships and fellowships for students in the sciences and engineering to learn the Japanese language, conduct research in Japan. So, it's——

Mr. **Valentine**. Do you receive any grants or any offers of possible future funding from private corporations which are likely to benefit from what you do? For example——

Dr. **Coleman**. Um-hum.

Mr. **Valentine** [continuing]. The corporations that are now involved in the Research Triangle Park and have facilities there.

Dr. **Coleman**. At present for the Japan Center's building funds, two North Carolina-based utilities have contributed. Otherwise, there is no participation from any private sector at this point. And, pardon me, one of the State's major banks has also contributed to the Japan Center building fund. We do not receive program support from private sources as yet.

Mr. **Valentine**. How many people are involved? How many of the center's faculty and other support people?

Dr. **Coleman**. The center staff itself consists of a director, myself, the associate director, two members of the Japanese language faculty, one secretary, and a part-time secretary.

Mr. **Valentine**. Has this—I don't know whether this is the right terminology or not, but have you become a regular line item in the budgetary process of that university or is it kind of experimental?

Dr. **Coleman**. The center, I believe, is a line item. The center has become a line item in the university budget.

Mr. VALENTINE. You mentioned some similar work at Massachusetts Institute of Technology and Dr. Johnson referred to a similar institution, I believe, in Minnesota. Where else in the country are we addressing the problem that your institution was designed to fund?

Dr. COLEMAN. We are still in the process of finding that out. I think much of the representation of university efforts where we've taken Japan's specialists, people with knowledge of Japan, plus an abiding and professional interest in what happens in the scientific community. I think you are seeing it. It is Eleanor Westney, it is Jim Bartholomew; you've had Susan Goldman here, myself as well.

We are currently interested in finding out about other centers of activity. Such activity is taking place, though, outside of the established academic organizations for Japan specialists.

Mr. WALGREN. If the gentleman would yield. How do we know that? How do we judge the size of that effort, or that capability?

Dr. COLEMAN. Well, one thing that I would note is that with the programs and plans that my colleagues and I have come up with, although they are intellectually quite solid and practical and commonsense, nevertheless, they are not recognized academic specialties, so that there may be independent pockets of innovation here and there, but I would be surprised. You take a look at our own funding and it's because of the State's initiative to develop economic ties with Japan to attract Japanese capital. You take a look at MIT, and as Eleanor Westney pointed out before, a lot of this is a labor of love; they are working on a shoestring. They've got a 150 percent job description there.

So for those reasons, because it is not an established specialty within Japanese studies, because the funding right now is coincidental. I think it's fairly safe to assume that there aren't all of these people reinventing the wheel, and yet out of contact with one another. We're still looking for other specialists. But for the reasons I've given you, I'd be surprised if they are there. And, again, they are not communicating via the established channels for Japanese specialists; we have yet to see interest within the established channels for Japanese specialists like the Association for Asian Studies.

Mr. WALGREN. If the gentleman would yield further. Is there some way that we could make an approximation of how large the effort in this area is? We say we've brought before the committee just about all the Japanese specialists who are concerned about this area who exist in the whole United States, And then we hear there is something going on out there in the private sector but we don't really have any way of judging whether that's a significant effort. Is that, too, just a scintalla or dimension that does not deserve to be considered as extant?

Dr. COLEMAN. Well, the National Science Foundation has recently expressed an interest in this issue as well, and they've been very supportive. We are holding discussions with them on the issue of surveying the situation, finding out, because I, myself, would definitely not want to leave anybody out in the academic community that's making a contribution.

Mr. VALENTINE. Dr. Coleman——

Mr. WALGREN. Mr. Valentine.

Mr. **Valentine** [continuing]. You now, according to the biographical sketch, have a distinct advantage over other people in your knowledge of the Japanese language because of your spouse. I believe she—doesn't she teach——

Dr. **Coleman**. I think putting that in was a liability. [Laughter.]

Mr. **Valentine**. She is assistant professor of Japanese at North Carolina State.

Dr. **Coleman**. I learned the language before we married. She claims no responsibility for any mistakes I make, and she's deeply embarrassed when I make them. [Laughter.]

Mr. **Valentine**. But now given that that is a real problem in this area, how long would it take a student at North Carolina State University who has to be smarter than the average Congressman, or he wouldn't be that in the first place [laughter] to take other courses that are required, and to become proficient in the Japanese language?

Dr. **Coleman**. Well, I think I can answer that in terms of the variables that are involved. One of them is: Will that student be involved in language courses that are designed to meet his or her needs?

Another one is: Will that student have some time in Japan? And will that student be taking part in intensive language courses?

I think all in all, you—if you do a combination of classroom plus, say, a year to 2 years in Japan, you are talking about 5 years of effort all in all, crudely speaking. Summer intensive language courses definitely help; time in Japan in, say, activities related to the person's technical and scientific speciality, and centering upon language study, would really speed up the process a lot. But the thing is there are no magic bullets; it takes time. It's a long-term investment.

Mr. **Valentine**. Thank you.

Mr. **Walgren**. If the gentleman would permit, if 5 years would be largely just the language component, and if you're talking about becoming educated in a specialty or a discipline, you're suggesting a program that has to be substantially longer than 5 years.

Mr. **Coleman**. Thank you for allowing me the chance to clarify. No; it does not. For example, a summer intensive language program that's geared to classroom work during the school year; that would be devoted to the language. But the school year work, that would be modest progress, would not conflict with the student's other studies. They would be integrated with them so that that student could progress in fields like calculus and physics—very demanding fields.

And then at a certain point, after 3 years or so of language study, that student can move into language study that's intimately related to his or her professional specialty, so they start getting feedback—perhaps say 4 years of language study. Then at that point they can put their language interests even more closely into their professional interests and get feedback between the two.

Mr. **Walgren**. Can you suggest the degree of motivation, or the breadth of interest in this area among students? I'm sure that the reason we haven't had many students in this in the past is because we haven't had that much contact with the Japanese culture. Are there enough people who would be interested in focusing on Japanese as a language and as a culture that early in their development as science students or technical students to make it a realistic thing to happen?

Dr. COLEMAN. Most certainly. One thing I might mention is that these students do not target careers and say, well, I'm going into electronics or I'm going into life sciences, and I know that Japanese will help. They have a kind of subconscious sense in many cases, that there are important and interesting things going on in Japan. And their first interest may be something like karate or judo. But they know that there's an intellectual challenge. And that's what attracts them initially.

And we have found that once they are in our Japanese classes, and people like yours truly get to them and tell them what some of the opportunities are professionally, that that's when they become even more committed to the language.

And their numbers will never be as great as, say, the numbers of students taking Spanish or French, because they know it is an extremely demanding language. But that's a self-selection process that we, in fact, can work very nicely with.

Mr. WALGREN. Thank you.

Mr. Boehlert?

Mr. BOEHLERT. Yes, Mr. Chairman.

Dr. Coleman, do you know what the language requirement is in North Carolina for a high school diploma?

Dr. COLEMAN. No; I do not.

Mr. BOEHLERT. And I'm afraid that that says something in a way, and that's probably the case all over the country.

Mr. Majcher, let me ask you: In New York we just went through a battle on a proposal by the State regents to have a 3-year language requirement for a high school diploma. And I'm sure you witnessed the same thing I did; everybody was up in arms and said that was terrible, much too demanding. Did you get involved in that at all, by chance?

Mr. MAJCHER. No, sir, we work primarily with the Rochester Institute of Technology in the University of Rochester in that area. We do not get involved at the high school level.

Mr. BOEHLERT. Well, my concern is this: I think we're—we're waiting too long to get 'em. I mean, I happen to have a son right now who's at the Defense Language Institute in Monterey, Calif., for a 15-month total immersion program in Arabic. But he is sort of a late bloomer in this area and it just bothers me that—I'm probably typical of a lot of people in the professional ranks, if you can call this business a profession; you know, college graduate with absolutely no proficiency. I speak 1½ languages: American and a little English. [Laughter.]

But don't you think we all should be pushing to get this thing going at a much earlier stage of the development? I mean—and weren't you—all of you had to be pleased with what we did last year in this committee and in the House with the emergency math and science legislation. We added, with some opposition, but we did it, we added the foreign language, critical foreign language.

Dr. Coleman, let me ask you: What about the program that enabled you to get your proficiency in Japanese? What happened to that one? Did it just sort of go by the boards?

Dr. COLEMAN. I believe so, yes.

Mr. BOEHLERT. And so you would——

Dr. COLEMAN. I was in the group that went through in the 1970's, in the early 1970's and late 1960's.

Mr. BOEHLERT. And as far as you know, that program no longer exists?

Dr. COLEMAN. Right, it is not funding graduate students in the social sciences.

Mr. BOEHLERT. That's too bad. We've got to get moving on that one, too. There are so many things we have on our agenda.

What about the other thing, on page 4 of your testimony, Dr. Coleman, you talk about you need funding support for summer intensive language courses with scholarship support.

Are you thinking in terms of developing a proposal under this emergency math and science and foreign language legislation? Because if the Senate proceeds, we are going to have a nice pot of money for summer institutes. And this might be just the type of thing that, with your track record in North Carolina, you could do very effectively. So I would encourage you to look at it.

Dr. COLEMAN. That's entirely possible, and I would like to learn more about it.

I also would like to note that many of our students who are taking Japanese also, of necessity, are taking part-time jobs while they are studying. As a matter of fact, in polls of our students in the last 2 years, almost all of the students taking Japanese were also holding down part-time jobs during the school year.

And what we have to compete with in giving students Japanese language education is the necessary summer job.

Mr. BOEHLERT. Take a look at it, I think there's promise there for you.

I want to commend you for what you are doing down there. I am jealous, being a New Yorker, I'm jealous of what's happening in North Carolina.

I want to thank all the panelists for participating today.

Mr. WALGREN. Thank you, Mr. Boehlert.

Mr. Johnson, you indicated that you had this feeling that a growing amount of literature in Japan was not being translated into English and that previously more would have been, or might have been. Is there discussion of that phenomenon in the Magnetics Society these days?

Mr. JOHNSON. Let me clarify that. What I meant to say was that historically the Japanese have published in English in addition to publishing in their own journals simply because the U.S. technical journals are preeminent in the world. And in the last several years, I would say 3 years, they have started to publish in Western journals mainly summary articles and overviews, and that sort of thing, with the new research being published in Japanese first and perhaps English later, if at all.

We have noticed in the Magnetics Society, a tremendous trend away from publishing initial research results in our own journal—initial, new discoveries, new technologies, new techniques, new processes, and so forth.

Eventually, they will end up in U.S. journals by the same authors but the Japanese have a problem in writing in English. And the review and editing process is fairly comprehensive and sophisticated in the learned technical journals, and you have to send the manuscript back and forth several times. And ofttimes it's a year to 2 years simply before the manuscript is published because of the review and editing process.

And, therefore, there's a tendency, especially as Japan starts regarding itself in some technologies as being No. 1, not to worry about communicating to their Western colleagues; they find it more important to communicate to each other. And that is a tendency which I have seen particularly in the last year.

Mr. WALGREN. So that's a new—that's sort of a——

Mr. JOHNSON. Kind of a new phenomena.

Mr. WALGREN [continuing]. New trend, anyway, that we could expect to continue?

Mr. JOHNSON. Yes; I think that's true.

Mr. WALGREN. And so that problem will become worse over the years, anyway.

You mentioned that your association is pursuing the translation of documents in your area through a office in Japan.

Mr. JOHNSON. It's an independent translation office run by Englishmen, most of whom have degrees in—all of them that I know of—have degrees in science and engineering. And whose second language is Japanese. And they've been doing this, it turns out, for 10 or 15 years. Their technical fit with us seems to be particularly appropriate.

Mr. WALGREN. They're British, they're not Americans?

Mr. JOHNSON. They happen to be all British.

Mr. WALGREN. Yes.

Mr. JOHNSON. But they speak English pretty well. [Laughter.]

Mr. WALGREN. Did your organization look at whatever is available through the NTIS in their indexes, and was that just not—

Mr. JOHNSON. Well, they want to do indexes. Excuse me. They want to do indexes which I think is essential. We were more interested in translating the—all of the articles appearing in our field.

That's one of the big problems, by the way, is the Japanese have no centralized indexing system. It's sort of done on a catch-as-catch-can basis, as near as I can tell. It's very hard to find articles on a given technology that appear outside of the appropriate journals.

Mr. WALGREN. Would you be at all satisfied to rely on the index of NTIS as being sufficient to lead you to the articles that you then want to translate?

Mr. JOHNSON. That becomes a problem, again, of what's going to be translated. If it's only the titles, probably not. If it's the titles plus the abstracts, that would probably be appropriate.

Mr. WALGREN. Mr. Majcher, its been said that there is a substantial amount of private translation going on, and I would guess that if anybody's engaged in private translation, a company like Xerox would be. Do you feel that, not wearing your Xerox hat, now, but as a public policy matter, we are making the most constructive effort, or justified effort in this area, in the private sector and in the public area together?

Mr. MAJCHER. Well, first of all, I'd take exception to the statement that there is an extensive amount of effort in the area of translations, primarily for two reasons.

First of all, as has been pointed out previously, there are very few technically competent translators. As an example, I've been looking for over 3 months now to hire a translator for some internal work requiring fluency in both Japanese and English, and a scientific, hard science background. To date, I have not been successful.

The second problem involved with that is when you rely on outside translating services, that gets to be extraordinarily expensive. There have been some cooperative efforts between librarians and various companies to join together and share some of that cost. But the cost is so exorbitant that it's almost prohibitive.

We, for example, translate one journal, Electrophotography; and it costs well over $7,500 a year to translate that one journal, cover to cover, and it only comes out three times a year. So there's essentially three issues.

So most private industry companies, that I am aware of, do not have a very significant effort in that area.

Mr. WALGREN. I see.

Mr. JOHNSON. Sir?

Mr. WALGREN. Yes.

Mr. JOHNSON. May I make a comment to that?

Mr. WALGREN. You certainly may.

Mr. JOHNSON. When these hearings were being organized, my company, as a member of the American Electronics Association, and I were asked if I could recommend anybody in industry in big companies. And I talked to a colleague of mine at IBM and asked him what they were doing, and he said they were doing everything internally through their office in Japan and had no need of a translation service.

Now, that is not available to anybody else. And it seems to me that it's small companies that need the help, not the big ones.

Mr. MAJCHER. If I might comment on IBM, without knowing who you spoke to, most companies do have access to technical information internally. But we also run into a problem there to the extent that our cooperative efforts—we do receive internal report type material of a scientific and technical nature. But for the most part, that is not translated; that's sent to us in Japanese.

In terms of access to public domain literature, journal articles, technical reports, conference proceedings: I've had several conversations with the IBM librarian and they have essentially the same problem we do.

Mr. WALGREN. I see.

Well, I think your statements stand clearly to focus on the lack of capacity that we have in this area, both in the present and the long term. And I appreciate very much your contributions to the record and I think they will be very helpful to others in leading them to appreciate the deficiencies that we now have. So thank you very much.

Mr. WALGREN. The last panel: Robert Gibson, who is the head of the Library Department of General Motors Research Labs; James Seals, who directs the international programs of the Chemical Abstracts Service, and William Budington, the executive director of the John Crerar Library in Chicago.

Gentlemen, welcome to the committee. We appreciate your effort in being here and giving some thought to this subject in a way that we can build a record for the consideration of the Congress.

As I indicated before, statements in writing that you would like to submit, and even further reflections, would certainly be welcome, and will be made part of the record. So please, we will appreciate hearing your—your highlighting of the points that you believe cry out the loudest to be made from your particular perspectives.

And let's begin in the order that I called you and go to Mr. Gibson first.

STATEMENTS OF ROBERT W. GIBSON, JR., HEAD, LIBRARY DEPARTMENT, GENERAL MOTORS RESEARCH LABS, WARREN, MICH.; JAMES V. SEALS, JR., DIRECTOR, INTERNATIONAL PROGRAMS, AMERICAN CHEMICAL SOCIETY'S CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO; AND WILLIAM S. BUDINGTON, EXECUTIVE DIRECTOR AND LIBRARIAN, THE JOHN CRERAR LIBRARY, CHICAGO, ILL.

Mr. GIBSON. Thank you, Mr. Chairman. I do appreciate the opportunity to speak.

First, I would like to make a disclaimer. I think I'm here primarily as the author of a book on Japanese scientific and technical literature, a subject guide, which was issued by Greenwood Press in 1981. And earlier in the testimony, we had some reference to GM and Toyota. I don't know anything about that and let's leave that completely out of the realm of the discussion.

I would like to concentrate on the results of the study that we made because I think that's the area that I have the most knowledge in. And in this concentration I'd like to especially hone in on the science and technological journals. Those are the most important pieces of the literature coming from—emulating from Japan that can be used by the American researchers.

In the study that our group made, we identified over 9,100 titles that were aimed somewhat in the areas that would be at all applicable to research being done at General Motors, so there would be some exclusion of agricultural and perhaps medical areas.

One of the first pieces of information we tried to determine was the amount published in English versus the amount still only published in Japanese. And our study indicated approximately one-fourth is printed in English.

Many statements have been made in the literature in the last few years that the Japanese published most of the good work in English. And from anything that I have been able to determine, as was mentioned earlier this morning, the Japanese also have a problem in the language barrier. And from the discussion with Japanese scientists in Japan, there was a strong indication that it is much easier for them to translate from English into Japanese than it is from Japanese into English.

The language barrier for utilization of this material, I think has been more than adequately covered. One of the points I did have *down was the—it seems to me that I remember in the MIT brochure* that they require at least 3 years of study in the Japanese language before they consider sending their exchange students to Japan.

Now, there are not many American students that are willing to start out, in fact, they don't usually, as you were—the point you were making, it comes late in life, and then trying to learn the Japanese language is a real problem.

When I went to Japan I tried. I finally gave up and decided I would look far better by not mispronouncing or any other of the little idiosyncracies that the arrogant Americans do have when they visit Japan.

The survey also honed in on another aspect and that was whether these Japanese titles were indexed or not indexed. Our assumption was that if a title is indexed in something like chemical abstracts or any of the other Western abstract services, it might be available to Western researchers. If it is not indexed, then its availability is essentially unknown. Only 20 percent of the total titles that we were investigating were indexed by anyone, and that also includes the work that JICST was doing.

The Japanese have very little internal bibliographic control. The best effort in that area is obviously JICST. Their publications indicate that they cover some 10,000 journals but only 40 percent of those are Japanese. So you—the main emphasis obviously is in the Western scientific and technical effort.

Of the approximately 3,500 titles, a closer discussion indicated with the people from JICST that due to various limitations, they also evidence money problems. And I think we should never forget the priority issue with any discussion of Japanese advances, they probably are only really covering about 2,000 titles in the JICST material.

Now, if we accept the premise that if the information is not indexed it is virtually unknown, there should be a significant amount of Japanese sci-tech literature that is not being used by the Western World.

At the time of the study, there were 1,732 items indexed and of that, 1,400 were indexed by Chemical Abstracts. I'm glad I'm speaking before you.

Obviously, the Chemical Abstracts Service has felt that there is material that is significant when they are using one-tenth of their resources in the coverage of the Japanese chemical literature. That left only 332 titles to—unique titles—indexed by the rest of the indexing services; a small number, indeed, for the coverage outside of Chemical.

We tend to be a bit arrogant, I think, on assuming that we know more than we do about the Japanese effort. And some of these things I'm saying, let's exclude the chemical area; I think that's a safe exclusion. But we do, obviously, need an organized plan for attacking this information.

We have talked about the need for translators. When we were doing this service, I ran into exactly the same problem; or when we did the survey—trying to find qualified people to translate in the technical area was exceptionally difficult.

I guess I was just naive when I started out in this idea, but I thought I could go to any of the international houses and find plenty of people who would be willing to translate for a fee. But to a person, as soon as I mentioned the technical areas, that quashed it rather rapidly. And we had quite a problem.

There is a strong need to increase the holding of Japanese titles in this country. One of the examples that I like to use is obvious, I am somewhat interested in the literature on land vehicles; so when we were doing the survey, I located approximately 72 titles out of this 9,000 that seemed to fit into this area.

When I tried to locate copies of these items in U.S. libraries, I only found four of them, and those were rather fragmented in holdings.

So document delivery, once we do know things are available, is a second major problem. And there is a need to index and abstract the information that has not been covered by anyone else.

Now, there seems to be some signs that there is some improvement in this area. You have heard of the North Carolina-Japan Center and apparently yesterday you also heard from the MIT-Japan programs. And as I emphasized, fluency in Japanese with these programs is so extremely vital.

The abstracting and indexing services are increasing their total amount of coverage but even so, outside of the chemical area it is a rather slim effort that is going on.

I suspect that Engineering Information, Inc., yesterday indicated that they were attempting to put together a proposal to index either 500 or 1,000 items—1,000 journal titles. This effort is a significant one except that I believe it is only translating tables of contents and does not have abstracts.

Most of our GM researchers feel that the lack of abstracts almost negates the translating effort, especially in the Japanese area.

There is a new service that is just coming to the fore from the Japan Technical Information Service that is intending to abstract and index some 400 titles. They will begin publication of a monthly journal probably in the beginning of July. I think this is one that several of us in the industry will be watching as it seems to be covering items that are of particular interest.

We do have some cooperative ventures among the various companies; informal, true, but all of this is not enough. And I think that there should be a strong coordinated plan which will have a combination of both governmental and private funding to cover this area.

Thank you.

[The prepared statement of Mr. Gibson follows:]

JAPANESE SCIENTIFIC AND TECHNICAL INFORMATION

Why should the Western world's researchers be interested in the Japanese scientific and technical information? One only has to be somewhat aware of the state of various components of the U. S. economy to know that the question is purely rhetorical. The Japanese have set out to do economically what they were not quite successful in attempting militarily. In this arena, they have proven themselves hardheaded competitors and competent adversaries.

As you are undoubtedly aware, industrial and economic activities in Japan have increased to such a level that industrial production capacity has surpassed all Western European countries, and Japan is now the second economic power in the free world. Japan currently ranks third in the world in total spending for scientific and technical research as well as supporting the world's third largest research labor force.

These facts concerning Japan's place in world scientific affairs raises certain questions about the literature that documents these research efforts. What are the Japanese publishing practices? How are research results made available? What information or periodicals are published in English?

In spite of seeing the results of Japanese know-how on the well-being of U. S. industries, very little is really known about Japanese sci-tech literature. One barrier immediately encountered is the difficulty of the Japanese language. Most of you are cognizant of the fact that the Japanese language is a combination of three orthographies (Chinese and two syllabic scripts) with a syntactic structure radically different from English. The number of different characters needed to produce an average edition of a Japanese newspaper is about 4,000. The complexity of the language and the difficulty in learning it has undoubtedly contributed to creating a language barrier which may well be the major reason why most of the information flow between the Western world and Japan has so far been one way (to the Japanese). As a result, Japanese specialists in various subject disciplines are currently far more aware of worldwide developments outside of Japan than are the Western researchers of corresponding Japanese developments -- a situation very similar to Western understanding of Russian scientific literature prior to the launching of Sputnik.

A second difficulty is the vastness of the Japanese publishing effort. Japan boasts the third largest publishing conglomerate in the world. In 1977 alone, over 3,000 Japanese publishers produced and distributed over 960 million copies of books and over 2.5 billion copies of magazines. One can easily understand that evaluating this literature is no small task.

In late 1977 as a beginning effort toward understanding the Japanese literature, a study was inaugurated at the General Motors Research Laboratories Library. Prior to our starting such a project, contacts were made with several individuals and agencies to determine the level of knowledge in this country of the Japanese sci-tech publishing efforts. The general impression from these contacts indicated a vague awareness of a significant amount of Japanese journal literature, but no awareness of any organized attempt to exploit this material for the use of the U. S. scientific community. After determining that our proposed study would not be duplicating prior or current work, the project was begun with two principal objectives. The first objective was to be an analysis of Japanese scientific and technical publications -- periodicals, books, and technical reports. The second was an overview of the Japanese technical publishing and disseminating activities. However, most of our effort went into studying the periodical literature as it is the most timely form of publication. The first phase of the project was a major effort aimed at the creation of a file of Japanese scientific and technical periodicals, restricting our choice to subject areas which were most applicable to GM Research projects, thusly, including little of the medical or agricultural areas. The project staff searched for the following information for each title:

Japanese title
Translated Title
Publisher
Beginning Date
Language of Publication
Subject Area

The final compilation included over 9100 pertinent scientific and technical periodical titles, a number which surprised the Japanese when the survey results were first discussed with Japanese information specialists from the National Diet Library. Full analysis of the study results are included in the publication, Japanese Scientific and Technical Literature: A Subject Guide, by Robert W. Gibson, Jr. and Barbara K. Kunkel, issued by Greenwood Press, Westport, Connecticut, 1981.

Analysis of the data collected in the survey indicates that slightly less than one-fourth of Japanese scientific and technical periodicals are published in English leaving three-fourths still published only in Japanese. This figure ought to dispell the myth that the Japanese are publishing extensively in English.

Japan is very strong in the applied sciences so it is no real surprise that approximately 45 percent of the studied periodicals are included in this broad subject breakdown with the remaining categories of agricultural - 20 percent; medical - 18-1/2 percent; and natural sciences - 17 percent following in descending order.

An additional delineator in which we were particularly interested was whether the periodicals were regularly indexed by indexing and abstracting services, either Western or Japanese. If one accepts the hypothesis that Western researchers gain most of their knowledge of foreign publications through Western I & A Services, then articles in foreign periodicals which are not covered by these sources are virtually unknown.

The material obtained from selected Western indexing and abstracting services shows the following comparison of the number of Japanese titles indexed versus the total number covered.

Title	Number Japanese Titles	Total Number of Titles Indexed
Chemical Abstracts	1,401 (10.0%)	14,000
Engineering Information, Inc.	105 (5.2%)	2,022
Metals Abstracts	40 (5.7%)	701
Science Citation Index	80 (2.9%)	2,717

It is obvious that Chemical Abstracts indexes far more Japanese titles than any of the included services both by actual number and percentage. In fact, of the total of approximately 1730 titles indexed by all Western sources included in the survey, 1400 were indexed by the Chemical Abstracts Service. Some of the titles are indexed by more than one service.

A comparison of indexed titles to the total number of Japanese sci-tech periodicals included in the study indicates that information from only 19 percent of the periodicals are available to Western researchers through indexing services. As one would guess, 71 percent of the texts of this indexed segment are fully or partially in English or Western languages with 29 percent printed only in Japanese. Further, of the 81 percent that was not covered by Western indexes and abstracts, approximately 14 percent was printed in English and about 86 percent in Japanese.

One can deduce from this information that U. S. researchers may well be in for some "surprises" from Japanese researchers by virtue of the fact that Western scientists are not aware of a significant portion of the research being conducted in Japan. Yet, it has been both interesting and exasperating to have made the analysis and still note a relatively small concerted effort by U. S. information personnel to effect change in information awareness.

So, what is the information situation in Japan? Large Japanese companies such as Nissan, Toyota, Mitsubishi, Isuzu, and Sony do have research libraries utilizing such advanced techniques as online computer systems for accessing company documents and outside reports, for online data base searching and data base building. But they remain largely for company use only.

Governmentally, the National Diet Library (equivalent to our Library of Congress) issues the extensive Japanese Periodicals Index, Science and Technology (somewhat analogous to our Readers' Guide but not really subject machine searchable).

JICST (Japan Information Center of Science and Technology) is the keystone of Japanese sci/tech indexing and abstracting efforts. JICST was created by law in 1957 as a nonprofit making organization to: (1) collect worldwide scientific information comprehensively and to process it systematically; (2) disseminate information rapidly and appropriately to organizations and individuals, regularly and upon request; and (3) offer other far-reaching services to encourage the scientific documentation efforts of organizations and to assist them in the solution of complex problems.

Presently, JICST collects almost 10,000 foreign and domestic journals as well as technical reports, conference presentations, and patents. These publications are scanned, extracted, processed, and abstracted by over 5,000 scientists and engineers who are actively engaged in scientific and technical research throughout Japan. Only 41 percent (roughly 3,400) of the journals are Japanese. The average abstract is 300 Japanese letters (about 100 words of English) and the abstracts are assigned an average of six key words. The results of their work, plus input from the JICST in-house staff, go into the JICST data base in Japanese (Kanji).

Contact with Japanese governmental agencies such as MITI (Ministry of International Trade and Industry) revealed that there is no government-wide information data base or control system to which the technical community contributes results of our research nor from which they may query information similar to our NTIS. Many of the Japanese reports are not generally disseminated and, as a result, research is frequently repeated.

Among researchers in Japan there does exist an invisible college, but its effectiveness only extends to the point of public competiveness. Interviewed scientists agreed that if the invisible college let them down, it was more than likely that important information would be missed and research projects duplicated. They further indicated that it would be beneficial to the total research effort if the invisible college was replaced or supported by a more formal information exchange. Thus, increased bibliographic control would not only aid Western researchers, but would materially improve the intra-Japanese exchange of information as well.

Although emphasis has been made as to the difficulty for Western researchers to cope with the Japanese language, it would be only fair to point out that the language problem looms large in the list of Japanese problems as well. Too often assumptions are made that the frequent Japanese presenters on international symposiums are typical of most Japanese researchers. In fact, they comprise the minor segment of the research population. Many librarians and information specialists are likewise hampered by the lack of knowledge of other than their native language.

Traditionally, the Japanese have relied on their personal libraries rather than utilizing the public libraries. Libraries in Japan generally place more emphasis on collection building than on service as we are accustomed to expect in U. S. libraries. Libraries in Japan play a relatively passive role, and that fact, coupled with the achievement of nearly universal literacy in Japan since the turn of the century, leads the Japanese to buy, rather than borrow, the majority of their monographic reading material. There appears to be a bookstore on almost every other corner. Thus, the bookstore is far more accessible than the libraries, which would account for the fact that the Japanese buy more books per capita than any other nation. In 1977, the Japanese bought an average of six books per year for every man, woman, and child in the country. Japanese researchers likewise have fairly extensive personal collections of technical material and this may be another factor why there has not been a greater call in Japan for well developed indexes and abstracts of scientific and technical literature.

Japan has demonstrated its capability to produce information processing products. Their research in computers started early and almost immediately received governmental aid. The Japanese computer market is now the second national market in the world. However, computerized (or any) bibliographic control of the Japanese technical literature has always had a rather low priority. The Japanese scientists have historically taken little interest in the use of printed indexes, a fact which contrasts to the demand for such searching tools in most Western research libraries. If a higher priority is placed on internal data bases, the Japanese will undoubtedly move ahead rapidly as they have in solving the terminal keyboard problems. However, the Japanese information processing community must still overcome huge problems involving the language structure, cultural restrictions, and lack of experience in data base creation.

Some recent events do portend future changes in Japan. In September 1980, the Japanese International Telephone and Telegraph Public Corporation started its international computer access service commonly called ICAS. It marked the real beginning of the online age in the country, and most major foreign information services are available. Prior to this development, the Japanese concentrated on purchasing data bases produced elsewhere outside the country and operating them on locally developed computer systems for either offline or online searches. More effort has been expended towards the development of systems and services whereby locally generated specialized subject information is provided online to users by several organizations -- the Japan Patent Information Centre and the Japan Pharamaceutical Information Centre being good examples.

The Japanese also have a growing concern resulting from problems with document delivery similar to that evidenced by Western users of I & A Services in locating Japanese references. An example of this difficulty in the U. S. is shown by attempts to locate copies of journals from a sub-set compiled during the survey which possibly could have contained information on automobiles or the automobile industry. It was painfully significant that of these 72 titles, only 4 were readily available in U. S. libraries. And further, the actual holdings of these titles were spotty. Thus, even if we locate pertinent references to Japanese materials other than titles now included in Western I and A Services, the probability of document delivery is slim. The possibility does exist to request copies of articles from the National Diet Library in Tokyo, but there is a major time factor involved.

In Japan, the Resource Centre Scheme was established as an attempt to answer one recommendation of the 1980 report of the Science Council of Japan on new science information systems. The recommendations include three major items: first, improvements in the provision of online information services; second, strengthening primary document collections and improving ways of means for making them available; and third, promoting the production of Japanese data bases and the international cooperation in the input of Japanese information into data bases produced elsewhere in the world. To date, few results of action on the recommendations have been observed.

In a recent National Diet Library Newsletter, it was noted that "only a part of scientific research information in Japan is provided through international information sources, and a larger part of it still remains unknown abroad. In order to improve this situation, the National Diet Library should investigate and work out an innovative measure in collaboration with the institutions concerned;" and subsequently from a March 1983 issue of the Japan Economic Journal:

> "The Ministry of Posts and Telecommunications has decided actively to promote the international sales of Japan's computerized business and industrial information data bases and has organized a government-industry research panel for the purpose."

Thus, the Japanese, seemingly, are becoming increasingly aware of this Western world interest in their technical literature.

And from the same periodical concerning the NTIS-Japanese high-technology information agreement:

> "With the increasing superiority of the Japanese capability to develop technology in such high-tech fields as very large scale integration, atomic power, or fiber-optics communication, NTIS has apparently judged that information on Japanese technology will be indispensable for future effective research in the U. S. To what extent the Japanese research and development results will be practically utilized in America is being watched with interest."

This article reflected the Japanese view of an agreement to exchange Japanese Research reports with NTIS. To date, nearly 3,000 items of Japanese source have been processed. Thanks to an online capability to search NTIS, it is easy to check this input. Of the total, only one hundred and seventy were published in 1983. A start in the information flow, but definitely not a flood, especially when comparing the 170 Japanese reports to the over 27,000 U. S. reports made available in the same time span, nor is this "trickle" indicative of the total number of reports written by the Japanese research institutes.

So much for evidence of possible changes in Japanese thinking in this area. What signs are there of corresponding enlightenment in our country?

It has been surprising that there has been no obvious evidence of a real surge in U. S. surveying the Japanese scientific literature, especially by companies currently being clobbered by their Japanese counterparts. Some are pushing individual efforts in this direction -- but nothing like either a national program similar to that inaugurated after Sputnik for Russian technical information nor industry-wide supported projects. Companies such as Texas Instruments, IBM, Control Data, GTE Microcircuits, Corning Glass, and Xerox with special interests in Japanese technology do have in-house programs for garnering and exploiting the Japanese information, but these are not coordinated efforts in any way. Most of these efforts are quite involved, attempting to bring together information from journals, newspapers, patents, personal visits, trade shows, seminars and meetings, which is analyzed to predict current technology and future trends. There are few other signs that American scientific community is waking up to the possibility that there may be information in Japan that should flow in reverse fashion similar to the flow from us to Japan.

Some programs have been introduced in academia similar to the MIT-Japan Science and Technology Program. It is the purpose of the MIT-Japan Science and Technology Program to establish MIT as a leader in the education of American scientists, engineers, and industrial managers about Japan. An associated goal is to facilitate collaborative research among mature Japanese and American scholars. Both aims are to be accomplished through the development of a variety of integrated activities both in Cambridge as well as in Japan. Three years of Japanese language training is a requisite for any students going to Japan.

Similar programs are in existance at other universities. Northwestern University's Center for the Study of U. S.-Japan Relations and North Carolina State University are examples.

The MIT-Japan program has held two seminars of special interest to Japanese information. The first held in September 1982 was entitled, "High Technology and Japan's Industrial Future." Dick Samuels, head of the MIT-Japan program said during the meeting, "Our perception of Japan and its development of technology has been strikingly and very suddenly transformed. It really is a very curious combination of awe and admiration--in fact, dread--that now dominates discussions of this new, Japanese high-tech challenge, and permeates those discussions is a pervasive ignorance." The second workshop occurred in January 1983 on the topic of, "Japanese Scientific and Technical Information." This session sponsored by the U. S. State Department brought together individuals from libraries, industrial organizations, disseminators of scientific and technical information and governmental agencies to share their knowledge in an attempt to identify points of access, organizational activities, U. S. library collection strengths, common problem areas, and useful reference materials. The results tended to verify a conclusion from the GM Research study, namely, that there is a great void in awareness and understanding in these areas.

Last May, the European Community Commission sponsored and co-financed a mission of technology transfer specialists of EC Member countries to Japan to promote the acquisition of Japanese technology by European companies.

Several workshops are springing up around the country similar to the "Third U. S.-Japan Automotive Industry Conference" held at the University of Michigan, Center on Japanese Studies, or "Meeting the Japanese Challenge, an Integrated Approach for American Industry" at the same University's Graduate School of Business Administration.

Similarly, new publications are being introduced to help alleviate our lack of awareness of Japanese technology. One recent addition to this group of services is the Oa/Fa Update. A monthly "Report on Japanese Office and Factory Automation," published by the Japan Information Service in Austin, Texas.

Even with increased attention to the problem of Japanene scientific and technical information, little real progress has been visible concerning an organized approach to published journal articles. The GM team was interested in comparing the current number of Japanese titles indexed by the selected group of Western I & A Services to the original survey statistics. There has been some growth in the coverage since the end of the initial study. These comparisions are shown:

INDEXED JAPANESE PERIODICALS

	1979	1983	% Increase
Chemical Abstracts	1401	1548	10.5%
Engineering Information, Inc.	105	115	9.5%
Metals Abstracts	40	113	183.0%
Science Citation Index	80	108	35.0%

The numbers represent a significant increase percentagewise, but even with these added titles, the actual number of unindexed journal titles leaves a vast amount of unknown material.

Reiterating the emphasis placed on the chemical portion of the Japanese literature earlier in this statement, it should be obvious that at least in the chemical area there is a high percentage of Japanese periodicals covering new developments in chemistry. Interpretation of these figures strongly indicates that there are other such disciplines which should be treated with the same degree of thoroughness.

Since the A & I Services are unable to commit more of their resources to Japanese input, it may be that those of us interested must band together to augment the A & I effort. Without adequate Japanese bibliographic control, some organization must begin processing additional non-indexed materials or we will never know if there is a quantity of "good" technical and scientific information which remains untapped.

There are two new proposals which are in the initial discussion stages. One of these is the proposal from Engineering Information, Inc. for a Japanese awareness service (JAS) which will cover either 500 or a 1000 core Japanese periodicals depending on the initial support base. The second is a proposal to start a new abstract journal covering 400 Japanese technical periodicals by the Japanese Technical Information service. Both of these services are intriguing to those of us who are strongly interested in Japanese scientific and technical information. However, supposing both of these services make it beyond the proposal stage, there will be a major portion of the Japanese scientific and technical periodicals which still will not be covered by anyone. Scanning this body of information for material pertinent to the U. S. scientific and technical community is a major task. It is high time that there is governmental support to augment what is being done by others so that it would be possible to have a fairly complete coverage of what is available. At the same time, there should be a concerted effort to provide holdings of the major portion of the Japanese scientific and technical periodicals in one of our American libraries. This portion of the effort likewise needs governmental support.

February 1984

VITA

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Publications:

Gibson, Robert W., Jr., Kunkel, B. K. Analysis of Information Activities and Bibliographic Control in Japan: Scientific and Technical Literature. Book published by Greenwood Press, Westport, CT, 1981.

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----------.; Kunkel, B. K. How the Engineer Can Best Use His Library. SAE Paper 780096. (1978). GMR-2671 (General Motors Report).

Professional Activities and Association Memberships:

American Association for the Advancement of Sciences - member

American Chemical Society - member

American Library Association - member

American Society for Information Science - member

Continuing Library Education Network and Exchange (CLENE) - member

Michigan Interorganization Committee for Continuing Library Education (MICCLE) - past chairman; currently SLA representative

Michigan Library Association - member; Active in numerous activities and served on various committees.

Special Libraries Association - member; Past president; 75th Anniversary Committee - chairman; 1984 Program Committee - member; Education Committee (Michigan Chapter) - member. In addition, has given several presentations on "Special Libraries."

Transportation Safety Information Committee - member

Special Libraries Association/National Commission on Libraries and Information Science Task Force on "The Role of the Special Library in the Nationwide Networking and Cooperative Programs" - member

Friends of the Lapeer County, Michigan, Library - member of Citizens Committee to Spearhead an Addition to Lapeer County Library

Participated and moderated a session at the Engineering Conference on "Innovative Management of Technical Information Functions Industry," held in Rindge, New Hampshire, in 1977.

Participated in a MIT-Japan Science and Technology Program workshop on "Sources of Japanese Scientific and Technological Information," held in Cambridge, Massachusetts, in January 1983.

Presented a paper, "Japanese Scientific and Technical Literature - An Update." at the Special Libraries Association Annual Conference in New Orleans, Louisiana, June 1983.

Personal:

Born in Canova, South Dakota
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Mr. WALGREN. Thank you very much, Mr. Gibson. We certainly appreciate that perspective.

Let's turn to the order in which we came. Mr. Seals.

Mr. SEALS. Thank you, Mr. Chairman.

My name is James V. Seals, Jr. I am director of international programs of the American Chemical Society's Chemical Abstracts Service Division. I appear today with the authorization of the society's board of directors to present this statement.

We appreciate this opportunity to testify before the subcommittee. We are pleased that the question of availability of scientific and technical information is being addressed at this high level of Government.

Our main recommendation is that the Government should do more to support the initiatives of the U.S. information community to build an international network for scientific and technical information.

The American Chemical Society would welcome the support of the U.S. Government in extending this network to other countries and to Japan in particular.

A brief subscription of Chemical Abstracts Service, or CAS, will help define the basis of my views. CAS is an operating division of the American Chemical Society, a congressionally chartered nonprofit educational and scientific organization with a membership of more than 130,000 chemists and chemical engineers worldwide.

We provide a comprehensive abstracting and information service in the fields of chemistry and chemical engineering. Our offices are in Columbus, Ohio, where we employ approximately 1,200 people, including over 650 professionals in various fields of science and technology.

CAS monitors more than 12,000 scientific and technical periodicals from approximately 150 nations for new information relevant to chemistry or chemical engineering. We monitor patents and patent applications issued by 25 nations and 2 international bodies, as well as proceedings of symposiums, dissertations, technical reports, and books from around the world.

We prepare English language abstracts and indexes for more than 450,000 scientific papers, patents, and other documents annually. About three-quarters of these documents are from outside the United States and are published in more than 50 languages.

Through our Patent Index, we also identify another 100,000 patent documents that contain essentially the same information as previously abstracted patents.

All the information generated by our professional document analysts is recorded in a computer data base from which we produce a variety of publications, including indexes and other information services, for distribution worldwide.

Our most comprehensive and best known publication is Chemical Abstracts, which has subscribers in over 100 countries.

We also operate a computer search service that permits international on-line searching of our data base, and through our document delivery service, we offer copies of the original documents covered in Chemical Abstracts to users worldwide.

Recently, we joined with the West German National Information Center for Energy, Physics, and Mathematics to form the first link in what will become a worldwide computer network for scientific and technical information.

We are working actively to extend this network, which is known as STN International, into Japan. This network will improve American access to valuable Japanese and European scientific and technical data bases.

Over the past two decades, the number of Japanese scientific papers has increased steadily and rapidly, both in absolute numbers and as a percentage of the total world literature we monitor. In 1983, Japanese language literature constituted more than 10 percent of the material covered in Chemical Abstracts, while 17 percent of the documents we covered in all languages were based on research done in Japan.

Of the patent documents abstracted by CAS in 1983, 49 percent were Japanese. A change in the Japanese patent law in the early seventies resulted in a very large increase in the number of patent documents published annually by the Japanese Patent Office. When this occurred, we were faced with a very difficult task. We had to gear up rapidly to handle the sudden vast increase in the volume of potentially very valuable Japanese language documents. We are now able to handle this material in a timely manner partly through the assistance of our Japanese associates. Part-time abstracters in Japan currently provide about 20 percent of our abstracts of Japanese material. The other 80 percent are prepared by full-time professional staff in our Columbus offices.

Overall, we find the Japanese very cooperative. We work particularly well with the Japan Association for International Chemical Information, or JAICI. JAICI serves as our agent for marketing and distributing CAS services in Japan and assists us greatly in our effort to provide more complete coverage of the Japanese scientific and technical literature.

We believe Chemical Abstracts Service is as comprehensive in its coverage of Japanese publications in chemistry as any organization in the West. However, we know our coverage is not absolutely complete.

There is some indication that, in recent years, information relevant to chemistry or chemical engineering has been added to the data base of the Japan Information Center for Science and Technology, JICST. Some of this information has not been covered by our service.

We are investigating this situation and anticipate the full cooperation of JAICI and JICST in insuring comprehensive coverage of the Japanese literature in Chemical Abstracts.

The JICST data base covers Japanese documents in all areas of science and technology. Some of these documents are not covered in any Western data base. However, we have no evidence that the Japanese are consciously attempting to prevent access to this information from outside Japan.

JICST offers its data base to the public through the JICST online information service, JOIS, and we are aware of no restrictions imposed by the Japanese on access to that service. Nevertheless, in order to use JOIS, one must be aware that the service exists, must know how to access the service through the public value added networks, must have computer terminals capable of handling the Japanese character set, and must know how to search in the Japanese language. These constitute a formidable de facto barrier to access by scientists and engineers outside Japan.

We would like to point out that substantial differences exist between the U.S. approach to the dissemination and exchange of scientific and technical information, and the corresponding approaches in Japan and the European nations.

In the United States, a strong, pluralistic information industry was built mainly through the efforts of scientific and technical societies and other nonprofit organizations, and through the entrepreneurship of commercial organizations.

The success of the U.S. information industry was aided significantly by U.S. Government support for the development of technology used in information activities. Such support was strong in the 1950's and 1960's, but has been severely reduced in the last decade.

On the other hand, France, Germany, and Japan have made it a matter of Government policy to establish strong national information systems. The European nations also want to build a strong European information industry to compete with that in the United States.

There are strong and well established information programs in certain fields in some U.S. agencies, such as the National Technical Information Service, the National Bureau of Standards, the National Library of Medicine, the Department of Energy, and the National Aeronautics and Space Administration.

However, it appears that the U.S. Federal policymakers are not sufficiently aware of the policy issues concerning information transfer and information technology. This virtual absence of national policies in the United States is in sharp contrast to the situation in Japan and the industrial European nations.

So far, the pluralistic approach in the U.S. information community has been highly successful. In fact, Japan and most European nations rely heavily on U.S. data bases and information services for access to scientific and technical information from outside their own nations.

However, in recent years, organizations engaged in the information business in the United States have been operating at a great disadvantage compared to their foreign counterparts. For example, the American Chemical Society, which is a private, nonprofit organization, providing services internationally, and committed to the free flow of chemical information worldwide, finds itself competing with heavily subsidized Government-industrial complexes in other nations. We are doing so without strong support from our Government and, we fear, without sufficient Government interest or concern. There is no agency in the Federal Government with clearly assigned responsibility for overall policy regarding scientific and technical information.

We believe that the U.S. Government can act to improve our access to scientific and technical information from international sources, and in particular from Japan. This would require that a national policy be adopted to encourage the U.S. information community in its efforts, and to foster international cooperation between U.S. organizations engaged in information activities and their counterparts in other countries.

The American Chemical Society would welcome expressions of support by the U.S. Government, in political and diplomatic arenas, of our efforts to extend the nonprofit STN computer network for scientific and technical information to other countries. STN International has already received strong political and financial support from the highest levels of the West German Government.

The Government of Japan, through its Science and Technology Agency, has also expressed strong interest in the network, and a desire to cooperate with the U.S. and West German scientific communities in the network's operation. A similar expression of interest and support on the part of the U.S. Government would greatly underscore the importance of this project to our Nation.

In conclusion, please permit me to make a few personal observations drawn in large part from preceding testimony.

I believe we face three major problems in the United States with respect to scientific and technical information. The first problem is ignorance in the U.S. scientific and technical community of the importance of information, how to gain access to information, and how to use information.

There is also widespread ignorance of important foreign languages, and Japanese in particular. The proper response to ignorance is education. And it is the proper role for the Federal Government to support education.

The second problem lies in the sheer volume of scientific and technical information available. Efforts to provide more information, without further education, are like offering more water to a drowning person. The solution, again, is education and, second, application of available technology to simplify access to information.

The third problem is difficulty of access to information. There are literally thousands of sources of information spread all over the world. The answer is unification. Information is presented in highly diverse ways. The answer is standardization.

And, finally, information is expensive. Costs, however, can be reduced by cooperation. We need cooperation on a national and international level. We need cooperation between the public and private sectors of the information community within our Nation. And we need cooperation between the profit and the nonprofit sectors of our private information industry.

Mr. Chairman, that concludes my testimony. Thank you.

[The prepared statement of Mr. Seals follows:]

STATEMENT

of

JAMES V. SEALS, Jr.

on behalf of the

AMERICAN CHEMICAL SOCIETY

to the

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

on

THE AVAILABILITY OF JAPANESE SCIENTIFIC AND TECHNICAL INFORMATION IN THE UNITED STATES

March 7, 1984

Mr. Chairman and Members of the Subcommittee:

My name is James V. Seals, Jr. I am Director of International Programs of the American Chemical Society's Chemical Abstracts Service. I appear before you with the authorization of the Society's Board of Directors to present this statement.

We appreciate this opportunity to testify before the subcommittee. We are pleased that the question of availability of scientific and technical information is being addressed at this high level of government. Our main recommendation is that the government should do more to support the initiatives of the U.S. information community to build an international network for scientific and technical information. The ACS would welcome the support of the U.S. government in extending this network to other countries and to Japan in particular.

Chemical Abstracts Service

A brief description of Chemical Abstracts Service (CAS) will help define the basis of my views. CAS is an operating division of the American Chemical Society, a congressionally chartered non-profit educational and scientific organization with a membership of more than 130,000 chemists and chemical engineers. We provide a comprehensive abstracting and information service in the fields of chemistry and chemical engineering. Our offices are in Columbus, Ohio. We employ approximately 1,200 people, including over 650 professionals in various fields of science and technology.

CAS has been in operation since 1907. Today we monitor more than 12,000 scientific and technical periodicals from approximately 150 nations for new information relevant to chemistry or chemical engineering. We monitor patents and patent applications issued by 26 nations and two international bodies, as well as proceedings of symposia, dissertations, reports, and books from around the world. We prepare English language abstracts and indexes for more than 450,000 scientific papers, patents and other documents annually. About three quarters of these documents are from outside of the United States and are published in more than 50 languages. Through our Patent Index, we also identify another 100,000 patent documents that contain essentially the same information as previously abstracted patents. These are known as "equivalent patents."

All the information generated by our professional document analysts is recorded in a computer database from which we produce a variety of publications, including indexes and other information services, for distribution worldwide. Our most comprehensive and best known publication is Chemical Abstracts, which has subscribers in over 100 countries. We operate a computer search service that permits international online searching of much of the content of Chemical Abstracts since 1967. Included in this service is a file of information on over 6 million chemical substances reported in the scientific literature since 1965. Scientists in about 20 nations currently search this file through our on-line computer service.

Recently, we joined with the West German national information center for energy, physics, and mathematics (Fachinformationszentrum Energie, Physik, Mathematik GmbH) to form the first link in what will become a worldwide computer network for scientific and technical information. We are working actively to extend this network, which is known as STN International, into Japan. This would improve Western access to some valuable Japanese scientific and technical databases as well as Japanese access to U.S. and European databases.

CAS has abstracted and indexed the Japanese literature in chemistry and chemical engineering since Chemical Abstracts was first published in 1907. CAS acquires Japanese literature directly from the academic, commercial, and government organizations that publish it. Most journals devoted primarily to chemistry or chemical engineering are provided to us as page proof or first copy off the presses which are forwarded by air mail. Over the past two decades, Japanese scientific papers (journal articles, conference papers, and reports) have increased steadily and rapidly, both in absolute numbers (Table I) and as a percentage of the total world journal literature we monitor (Table II).

Table I

Abstracts of Japanese Papers in Chemical Abstracts, 1961-1983

Year	Number of Papers	Percent of Total Papers
1961	10,413	8.8
1966	11,629	6.4
1972	21,934	7.9
1977	28,646	8.2
1982	38,739	10.2
1983	39,484	10.6

Table II

Sources of Journal Articles Abstracted in *Chemical Abstracts*, 1962-1983
(Based on the country in which the reported research was performed.)

Nation	1962	1966	1972	1977	1983
United States	28.4%	30.0%	28.0%	25.9%	27.1%
USSR	23.0%	21.3%	24.0%	23.2%	17.0%
United Kingdom	8.6%	6.8%	6.4%	6.2%	5.8%
Germany (East & West)	8.5%	6.8%	6.2%	7.2%	7.3%
Japan	6.9%	6.4%	7.9%	8.2%	10.6%
France	4.8%	5.0%	4.4%	4.2%	4.1%
Other Nations	19.8%	23.7%	23.1%	25.1%	28.1%

The number of patent documents issued by the Japanese Patent Office on chemical and chemical engineering inventions has grown even more dramatically (Table III). Of the 74,948 patent documents CAS abstracted in 1983, 36,640, or 49%, were Japanese.

Table III

Japanese Patents Cited in *Chemical Abstracts*, 1965-1983

Year	Basic[1] Patents	Equivalent[2] Patents	Total Patents
1965	1,767	250	2,017
1970	5,069	293	5,362
1975	27,546	12,285	39,831
1982	35,978	28,150	64,488
1983	36,640	28,848	65,488

NOTES: (1) Basic patent documents are those which contain the first disclosure of an invention.

(2) Equivalent patent documents contain repetitions of earlier disclosures.

The very large increase in the early 1970's in the number of Japanese patent documents abstracted annually resulted from a change in the Japanese patent law. This change allowed the Japanese Patent Office to publish *unexamined* patent applications (*Kokai Tokkyo Koho*) in addition to regular, *examined* applications (*Tokkyo Koho*). The number of examined patent applications issued annually on all subjects has grown from about 44,000 in 1971 to about 60,000 today. In addition, the Japanese patent office now issues over 225,000 unexamined applications each year.

When the Japanese patent law was changed, we faced a very difficult task. We had to gear up rapidly to handle the sudden, vast increase in the volume of potentially very valuable Japanese-language documents. We are now able to handle this material in a timely manner, partly through arrangements with our Japanese associates for additional help in abstracting and indexing Japanese patent literature. Part-time abstractors in Japan currently provide about 20% of our abstracts of Japanese material; the other 80% are prepared by full-time professional staff in our Columbus offices.

Overall, we find the Japanese very cooperative. We work particularly closely with the Japan Association for International Chemical Information (JAICI). This group was organized by scientific societies and the chemical industry in Japan specifically to cooperate with the American Chemical Society on matters related to exchange and dissemination of chemical information. JAICI serves as our agent for marketing and distributing CAS services in Japan. JAICI also assists us in our efforts to provide a more complete coverage of the Japanese scientific and technical literature.

We believe the Chemical Abstracts Service is as comprehensive in its coverage of Japanese publications in chemistry as any organization in the West. However, we know our coverage is not absolutely complete. There is some indication that, in recent years, information relevant to chemistry or chemical engineering has been added to the database of the Japan Information

Center for Science and Technology (JICST), the Japanese national abstracting and indexing service, that has not been covered by our service. We are investigating this situation and anticipate the full cooperation of JAICI and JICST in insuring comprehensive coverage of the Japanese literature in *Chemical Abstracts*.

The JICST database covers Japanese documents in all areas of science and technology. Some of these documents probably are not covered in any western database. However, we have no evidence that the Japanese are consciously attempting to prevent access to this information from outside Japan. JICST offers its database to the public through the JICST online information service (JOIS), and we are aware of no restrictions imposed by the Japanese on access to that service. Nevertheless, in order to use JOIS, one must be aware that the service exists, know how to access the service through the public value added networks, have computer terminals capable of handling the Japanese character set, and know how to search in the Japanese language. These constitute a formidable de facto barrier to access by scientists and engineers outside Japan.

Some European governments have recently taken steps to improve access to Japanese information in their nations. France, through its Center for Scientific and Technical Documentation (CDST), has reached an agreement with Japan whereby CDST will immediately establish an office at JICST to compile selected Japanese information and translate it into French. The agreement calls ultimately for the JICST database to be mounted online at CDST in France. The Federal Republic of Germany, through its Society for Information and Documentation (GID), has permanently stationed a Japanese-speaking scientist in Japan to locate pertinent information and make it available in Germany, and to facilitate the flow of German scientific and technical information to Japan.

Need for National Policies

We would like to point out that substantial differences exist between the U.S. approach to the dissemination and exchange of scientific and technical information, and the corresponding approaches in Japan and the European nations. In the U.S., a strong, pluralistic "information industry" was built mainly through the efforts of scientific and technical societies and other non-profit organizations, and through the entrepreneurship of commercial organizations. The success of the U.S. information industry was aided significantly by U.S government support for the development of technology used in information activities. Such support was strong in the 1950's and 1960's, but has been severly reduced in the last decade. On the other hand, France, Germany, and Japan have made it a matter of government policy to establish strong national information systems. The European nations also want to build a strong European information industry to compete with that in the U.S. There are strong and well established information programs in certain fields in some U.S. agencies, such as the National Technical Information Service, the National Bureau of Standards, the National Library of Medicine, the Department of Energy, and the National Aeronautics and Space Administration. However, it appears that U.S. federal policymakers are not sufficiently aware of the policy issues concerning information transfer and information technology. This virtual absence of national policies in the U.S. is in sharp contrast to the situation in Japan and the industrial European nations.

The pluralistic U.S. information community has been highly successful in the past. In fact, Japan and most European nations rely heavily on U.S. databases and information services for access to scientific and technical information from outside their own nations. However, in recent years, organizations engaged in the information business in the U.S. have been operating at a great disadvantage compared to their foreign counterparts. For example, the American Chemical Society, which is a private, non-profit organization providing services internationally and committed to the free flow of chemical information worldwide, finds itself competing with heavily subsidized government-industrial complexes in other nations. We are doing so without strong support from our government and, we fear, without sufficient government interest or concern. There is no agency in the federal government with clearly assigned responsibility for overall policy regarding scientific and technical information.

We believe that the U.S. government can act to improve our access to scientific and technical information from international sources, and in particular from Japan. This would require that a national policy be adopted to encourage the U.S. information community in its efforts, and to foster international cooperation between U.S. organizations engaged in information activities and their counterparts in other countries. The American Chemical Society would welcome expressions of support by the U.S. government, in political and diplomatic arenas, of our efforts to extend the non-profit STN computer network for scientific and technical information to other countries. STN International has already received strong political and financial support from the highest levels of the West German government. The government of Japan, through its Science and Technology Agency, has also expressed strong interest in the network, and a desire to cooperate with the U.S. and West German scientific communities in the network's operation. A similar expression of interest and support on the part of the U.S. government would greatly underscore the importance of this project to our nation.

Mr. Chairman, this concludes my testimony. I would be pleased to answer any questions you may have.

Mr. **Walgren**. Thank you very much Mr. Seals.

I am tempted to say off the record, George Brown, where are you when we need you?—which may be an inside story in the Congress. Mr. Brown, who many of you know, has been so interested in information technology policy; an area that has—has not been the focus of many Members of Congress. I am sure he will have input into this before the last word is spoken.

Well, let's turn then to Mr. Budington.

Mr. **Budington**. Thank you, Mr. Chairman. It's a pleasure to be here and we appreciate the opportunity of adding in these closing minutes our bit of information to your store.

As the Director of one of the country's largest research libraries in science, technology, and medicine, I can only back up very briefly what some of my colleagues have said in the need for more complete analysis of the foreign literature, of the Japanese literature, in terms of coverage of the—through the abstracting and indexing services.

Chemical Abstracts does an outstanding job, but if you look at the others—statistics on the other services, they are sadly lacking, and we can only hope that this will go farther, perhaps with a little encouragement, carrot, whip, or whatever, from this committee.

The availability of Japanese documents in this country was alluded to by Mr. Gibson a few minutes ago, in his failure to find appropriate documents, appropriate journals. The statistics again indicate a serious absence of the majority of Japanese publications in this country. The average research library will have 2 or 3 hundred. I think the Library of Congress may be the largest, with a couple of thousand. But getting hold of items when you need them depends upon the apparatus and machinery to identify the location; if they are not in this country, the machinery should be there to obtain them from Japan. Such machinery has been operative between the United States and Great Britain with the British Lending Library Division, in a very effective arrangement, which might be copied in communications with Japan.

Now, to turn to the part that I think I can contribute most on: We have talked about what translating does go on in this country; we have heard a report on what is currently done by JPRS, and the FBIS con—substantial amounts of it. Some reference was made to the fact that there may be some translating going on in the private sector. I think it's my job to indicate that there is, and that there has been for some 30 years, in an attempt to try to make the most of it.

It has been said that Japanese expertise in translating is exceedingly difficult to come by and it's exceedingly expensive when you find it. And the purpose of the operation which I represent, is that its—it is to point out how these obstacles can be countered to some extent.

The Crerar Library has operated for some 30 years the National Translations Center. This initially began as a project of the Special Libraries Association and was the undertaking of librarians who found that the expensive nature of translations, the difficulty in getting them done, encouraged them to share what they had. And these translations were, therefore, pooled, and in due course turned over to our institution to make the most of.

The 700 translations which we originally obtained in 1953, have now grown; we now have 350,000 in our files. We have records of 650,000 others, meaning that we have now records on 1 million translations, which are available on request. That, we—every year, or I'd say, the 30 years since we've been in operation.

We have provided access to 120,000 unpublished translations. That is a savings of some $50 million in translating effort which would have been necessary to expand had we not been able to provide this service.

Now, in terms of what is going on nowadays in translating, we add to our collection of translations about 15,000 items a year; 9,000 of these are actually deposited with us. We get notification of about 6,000 others.

These come from some 300 different contributing organizations; of these 300, 70 percent are industrial companies who are cooperating, sharing their effort, and pooling this information. Twenty percent of the depositors are government agencies. And I should add that its been a hard struggle to get them to contribute. Ten percent of our contributors are academic. We receive 8,500 inquiries per year. In respond to that—in response to that we provide them with access to about 2,400 translations; 50 percent of that through copies when actual translation; 50 percent referral to other locations. And of our users, about 60 percent are industry; about 30 percent various government agencies, and 10 percent academic.

Now, with respect to Japanese alone: We have in our files 60,000 translations from the Japanese; of that, 38,000 are in-house; 22,000 are available elsewhere, and we can make referral to them.

We are currently adding to our collection 5,000 translations from the Japanese each year; 3,000 of those are available in-house; the other 2,000 at other locations. This represents, in the private sector largely, $2 million worth of translating effort from the Japanese alone. So there is considerable amount going on.

The subjects which are represented are in—the strongest ones are in the field of chemistry and chemical technology, including food, materials, plastics, fibers, petroleum technology, environmental concerns, biomedicine, pharmacology, agriculture, fisheries, electronics, and communication.

I think that one of the things I would like to speak of here is the need for a great deal more of pulling together of coordination and cooperation of the government translating effort on the one hand, and the private sector translating on the other.

We heard of the very substantial amount and the commendable amount of translating done in the Federal sector. We also heard the phrase that this is available to the Federal community only. I would submit, of course, the old time-honored phrase that its been paid for with my money and I should have access to it. Most of it is, or a lot of it is from the open literature. It's not confidential—some of it, of course, obviously is.

The distribution channels are completely separate. The announcement channels are completely separated. And I think that some study should be given to the way of pulling this together. We are, in fact, giving, in our own sphere of the private sector, considerable study now to pulling together efforts underway in the petroleum community, and in the metals community, and in the textiles; each of which has got little indigenous collections of translations, and they are trying to do something with it. We think that, again, this all ought to be pulled together.

We are presently engaged in a substantial effort to upgrade our operation taking advantage of data processing facilities. My institution has not been able to support this operation with any funds. We have made the thing entirely self-supporting, and we think that has been a commendable effort in doing so.

We—we now have a—an advisory committee of eight senior information officers, drawn from IBM, from Du Pont, from a variety of commercial organizations which are concerned in the translating field. They are interested in helping us get started to eventually get on-line so that anyone can dial up probably through a commercial data base, and find out is there a translation of this item existing. You can do that in about 5 seconds. I leave it to your imagination what this might do to expedite access to Japanese scientific and technical information.

Some years ago, we did have support from the Federal Government, and appreciated it very much because it's really what helped us get started back in the late fifties when Sputnik went up and everybody got scared, and the Government was willing to put up some money in that area.

NSF was the principal funding agency until about 1972. But at that point underwent a serious policy change in which any subsidy to any organization was felt to be out of order and so they removed ours, they removed it from the science information exchange, and others, and insisted that they become self-supporting. Well, we did. We cut our staff in half; we boosted the price of our services; by doing so we made them unavailable to the academic community who couldn't afford it; but we made it go.

In recent years, its been a kind of a tough pull because we have not had Federal funding of any kind.

I should point out the only other center in the world similar to ours is located in Delft, and receives 80 percent of its funding from the Dutch Government and the rest of it is funding from the other governments in Europe.

And I would back up my colleague at Chem Abstracts that there is a serious discrepancy here between the operations of our Government and others in that respect.

I would just then close with the—the suggestion that using what translating effort we now exert, and making use of the product of that translating effort, could have a considerable impact on our access to Japanese scientific and technical information, if it is properly supported and coordinated.

Thank you, sir.

[The prepared statement of Mr. Budington follows:]

THE JOHN CRERAR LIBRARY

SCIENCE • TECHNOLOGY • MEDICINE

STATEMENT

by

WILLIAM S. BUDINGTON
Executive Director and Librarian
The John Crerar Library

before

The Subcommittee on Science, Research and Technology
Committee on Science and Technology
U. S. House of Representatives

on

MARCH 7, 1984

Mr. Chairman and Members of the Subcommittee:

My name is William S. Budington. I am Executive Director and Librarian of The John Crerar Library, an independent research library established in 1894 and located in Chicago. The Library specializes in the many disciplines of science, technology and medicine; its collections number nearly 700,000 volumes. It provides personal service to students, industrial and private re-

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searchers from the Chicago area, and through other specialized services it supports researchers in all parts of the U. S. and, indeed, the world over. Crerar Library is supported by endowment income, contributions, income from certain specialized fee services, and grant and contract project income. Our interest in and concern for these hearings stems from our long experience with the research literature of other countries, with problems of access to information and with language barriers. We are keenly aware of the sensitive area of Japanese scientific and technical information (JSTI), the problems of acquiring and coping with it, and with the need for greatly improved awareness of scientific and technical progress in that fast-moving country. I appreciate the opportunity of offering our perspective on some of these problems and describing certain services we have developed which may offer the basis for partial solutions.

My three-part presentation will focus on published literature and on what we call bibliographic access, physical access and language access. Briefly, these mean finding out what publications actually exist, getting your hands on the publications you really need, and getting around the language barriers that often are encountered. I will comment briefly on the first two points and at greater length on the language access problem, which in a sense overshadows all. I am aware, of course, that there are other channels for tracking JSTI than just the published literature, but will leave those to the appropriately experienced witnesses.

Bibliographic Access - abstracting and indexing

In general, the various ways we find out what has been published on a given subject are first, word of mouth; second, leafing through the magazines--both possibly chancy procedures--and third, consulting indexes. Bibliographic access guides include library catalogs and published indexes; the latter are known in the trade as abstracting and indexing services, or "a. and i." services. Committee members are familiar, I am sure, with Chemical Abstracts, Biological Abstracts, Engineering Index in both their printed and computer data base formats. Inclusion in and analysis by "a. and i." services is essential; otherwise there is no record of article, book or report and it is impossible to find out what literature actually exists. With respect to Japanese scientific and technical publications, the statistics provided in the 1980 article by Gibson and Kunkel* are conclusive. Over 9,000 periodical and serial publications were identified as issued in Japan. Only 1,729 or 19% of these were covered by the 21 principal "a. and i." services of the Western world. The other 81% are not indexed and are effectively hidden from us. The root problem has to be lack of language capabilities, in conjunction with knowledge of the subjects covered, a combination which is necessary to produce acceptable abstracting and indexing. Of the 1,729 titles covered, 72% are fully or partially in Western languages; only 28% are all in Japanese. Among the 21 Western "a. and i." services studied, duplication of coverage is evident, though this is commonly found with specialized services.

So, what are we to make of the bibliographic access problem? First, all

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* Gibson, Robert W., Jr. and Barbara K. Kunkel. "Japanese Information Network and Bibliographic Control." Special Libraries, v.71, no.3, p.154-162, March 1980.

9,000 Japanese periodicals and serials may not be worth indexing. We'll never know unless we can, somehow, arrange evaluations by competent subject professionals. Such selection processes are, of course, now carried out to some extent. But to another extent, the selection process for "a. and i." coverage is curtailed. First, many Japanese publications are expensive, and the "a. and i." people include what they can afford to buy or successfully beg. Second, a limiting cycle is in effect: we tend to index and abstract only those titles which are in demand, and we learn about and thus create demand only for the ones that are abstracted and indexed. Solution of the Japanese problem will require support and organization of an overall evaluation effort, followed by rationalization of and support for indexing and abstracting--quite possibly through existing services.

Physical Access

The next dimension of access is availability of the actual publications, once we are aware of the existence and content. The larger research libraries report holdings of a few hundred JSTI periodicals each; these collections very likely duplicate each other and concentrate on those titles having some Western language content and of recognized importance. The 2,000 titles reported by the Library of Congress may be the largest holding. Again, the evaluation process may determine titles needing immediate availability; however, some means should exist for obtaining copies of any and all periodicals having any research merit. Several options come to mind.

A thorough inventory of JSTI holdings in U. S. libraries could provide a starting base. Some use could be made of existing union lists, including

Chemical Abstracts' CASSI, New Serial Titles, the CONSER data base and the three national bibliographic utilities--OCLC, Research Libraries Network and Washington Library Network. JSTI titles lacking in this country's libraries could then be obtained through grant support to one or several depository libraries. This follows the 1950's precedent in which National Science Foundation funds initiated assured access at the Center for Research Libraries to foreign chemical and biological literature. CRL also arranged to receive a complete set of all publications issued by the great Russian Academy of Sciences. A final option might entail special document delivery arrangements with the National Diet Library and the Japan Information Center for Science and Technology in Tokyo. These might follow the pattern developed for U. S. library use of the British Lending Library Division services, either direct or through the Center for Research Libraries, using computer-based communications.

Language Access

Without question, the most significant barrier to effective awareness and utilization of JSTI is the scarcity of Japanese language competence, teamed with technical and scientific background and understanding. It is also without question that the supply of such competence must be increased on the one hand, and on the other hand, maximum use made of the competence that does exist. Increasing the supply will have to be addressed by others; I do recall the success, within limits, of the war-time language schools at Monterrey and elsewhere. MIT, North Carolina State and possibly other universities have programs addressing the need. Unfortunately, we are less able to cope with Japanese than was the case with Russian in the sputnik-sensitized 1950's and 1960's; then, there was a steady stream of political refugees which brought not only language knowledge, but some of our greatest scientific minds. We are not blessed with a similar influx of Japanese today.

How do we use such competence as we have? In the sputnik era, the cover-to-cover translated journal was one answer. The old Consultant's Bureau (now Plenum Press) provided a good example of private sector initiative organizing stables of translators and issuing several dozen cover-to-covers. A number of scientific societies also jumped in with cover-to-cover translations of Russian journals in their fields. In due course, nearly 1,000 such titles appeared, many with initial pump priming support by the National Science Foundation. Assuming careful selection of candidate JSTI titles, this enterprise might be productive in the present trauma. Finally, making best use of the translating efforts now in place is the message of the next section.

The National Translations Center

The John Crerar Library has operated this center since 1953. It does not do any actual translating work. Instead, its function is to serve as a depository and information clearinghouse on individual, unpublished translations which have been completed. The objective is to make these translations available to others having need for the same specific translations, so that making duplicate translations is avoided. In its 31 years, the Center has provided access to some 120,000 needed and requested translations; this has saved some $50,000,000 in duplicative, wasted translating expertise.

The idea for the Center originated with a group of industrial librarians following World War II. In their effort to catch up with advances abroad in science and technology, they faced high costs of translations, scarcity of good translators, and substantial time delay in production. To prevent duplication and waste, these librarians pooled their completed translations, sharing them for use by all. In due course, the size and management of this pool became burdensome; in 1953, their professional organization, the Special Libraries Association, contracted the operation to the Crerar Library and the SLA Translations Center came into being. Solicitation of copies of completed, unpublished translations was made to industry, government agencies, academic institutions and others. Regular listings began to be published, and some small grants from industrial groups enabled expansion. Contacts were made with like-minded agencies in other English-speaking countries. Notifications of translations available elsewhere were incorporated in the Center's files to permit referral of inquirers to over 100 other cooperating organizationsin the U.S.A. and abroad.

From the original collection of about 1,000 translations, the Center's holdings have grown to over 350,000. With about 650,000 records of items available elsewhere, the Center now provides access to about 1,000,000 translations. These are indexed by author, original journal of publication, report numbers and other identifiers. The files are checked annually for over 8,500 inquiries, received by phone, letter, teletype and electronic mail. Some 1,200 translations are provided immediately from the Center's files, and an equal number of inquiries are referred to other known locations. About 5,000 new translations are deposited each year; removal of any source indication is standard procedure, to allay proprietary concerns. Over 10,000 other location listings are added each year as well. A monthly announcement bulletin is published by the Center, Translations Register-Index.

Early support for the Center came from modest service fees and from contractual relations with the several forerunners of the National Technical Information Service. During the late '50's and the '60's, annual operating subsidies were provided by the National Science Foundation. A 1972 policy change on such subsidies removed that support, requiring a 50% cut in the Center's staff and operations. Self-support since then has come from fees and from the subscriptions to its monthly publication. The Special Libraries Association relinquished its interests in the Center in 1968, at which time its name was changed to National Translations Center.

Over 40 languages are represented in the Center's holdings. With respect to Japanese, some 60,000 translations from that language are now on hand; 49,000 are journal articles and about 11,000 are patents. About 1,550 different Japanese periodicals are represented. Of the total 60,000 records, 38,000 items are in the Center's collection, with the remaining 22,000 at other known locations. About 3,000 new Japanese translations are added every year, plus 2,000 notifications of availability elsewhere, making 5,000 new records per year. This represents perhaps $2,000,000 in invested translating costs per year for Japanese material alone. As to subjects represented, the most numerous Japanese current receipts are in chemistry and chemical technology--especially fibers and petroleum technology. Next come the environmental and biomedical sciences, particularly pharmacology. Agriculture, fisheries, and electronics and communication are also represented.

At present, planning is well along to upgrade the Center's internal operation from a largely manual effort to greater use of computer capabilities. Only the on-going, cumulating index of original, foreign language source citations is computerized. An advisory committee of eight senior industrial information officers is assisting with guidance and with contacts to corporate funding sources which will support the transition with equipment and dollars. The objective is full use of machine readable records for file creation, publication and on-line access by the Center's users. Spin-offs by subject, language, country of origin and other identifiers will be easily accomplished. Maintenance of an in-process file is also under discussion, to track translating efforts from beginning to completion, also preventing duplicate starts.

Interest in exploiting translations is having strong resurgence in our country. Several scientific and technical societies have considered establishing translations pools. Recent hearsay tells of a large, west coast corporate division proposing to establish a Center to collect and organize Japanese translations; were the officers to consult their own information staff, they would have been informed of the National Translations Center capabilities. With automated and on-line capabilities, the Center will strongly urge complete consolidation and centralization of all such interests. Through carefully shaped publicity, promotion of cooperative sharing should greatly enlarge the range of input and use of the Center. In particular, the translating activity in numerous federal agencies could be better marshalled, taking account of present vested interests and restrictions. Paid for by public funds, such translations from the open, foreign language literature should be made readily available.

The foregoing deals with the overall objectives, operations and plans of the National Translations Center. Most certainly, the current general concern for access to JSTI is well known to us. The symptoms are quite reminiscent of the late 1950's when sputnik went up and Russian literature was the target of the day. And now, receipts of translations and inquiries for Japanese material are beginning to outrun the Russian. It is interesting to note that in both Russia and Japan, scientific and technical information management and dissemination is highly centralized and supported by government funds. In our society, the activity is largely decentralized and with somewhat changeable federal support.

Improved access to Japanese scientific and technical information should and can be achieved. Testimonies of yesterday and today propose many thrusts worthy of study, coordination and support. I have paid brief attention to participation by libraries and the involvement of abstracting and indexing services--the physical and bibliographic access. The overriding language capabilities problem presents uncertain means of solution. I hope that our efforts to maximize the benefit of such translating as is carried on, will be of interest to the Committee and others and will receive support and encouragement. We stand ready to work on these problems; we hope and believe there is a contribution to be made, and we will welcome comments, questions and discussion.

Biographical Sketch of
WILLIAM S. BUDINGTON
Executive Director and Librarian
The John Crerar Library
35 West 33rd Street
Chicago, IL 60616

Education

B.A., 1940; L.H.D., 1975 Williams College
B.S., 1941; M.S., 1950 Columbia University, School of Library Service
B.S. (E.E.), 1946 Virginia Polytechnic Institute

Profession

Reference Librarian, Norwich University, 1941-42. Librarian, Engineering and Physical Sciences, Columbis University, 1947-52. Associate Librarian, The John Crerar Library, 1952-65; Librarian 1965-69; Executive Director and Librarian, 1969 -

Memberships

Special Libraries Association (President, 1964-65)
Association of Research Libraries (President, 1973)
Medical Library Association, American Society for Information Sciences, AAAS.

Other

Member USA/USSR Special Libraries Exchange Team, 1966. Visiting Committee on the Library, M.I.T., 1972-77. Panel member, M.I.T. Workshop on Japanese Scientific and Technical Information, January 1983.

Publications

27 articles in professional journals

Mr. WALGREN. Thank you very much, Mr. Budington.

Could you underscore this lack of Federal access, or access to something that does exist on the Federal level?

Mr. BUDINGTON. I—I think the—I pointed out, I think, that there is considerable access—considerable translating effort going on in the Federal community, which is fine. But it is—it is—can be accessed only by the Federal community——

Mr. WALGREN. Now, why is that——

Mr. BUDINGTON [continuing]. Basically.

Mr. WALGREN [continuing]. And who's doing it, and how does that come about?

Mr. BUDINGTON. Some of it, I'm sure, is due to security restrictions in the defense agencies, in the intelligence agencies, where a lot of this is going on. This data base that they mentioned, is—I think it even incorporates what we have in ours; so that they have access to the maximum quantity.

But the—the reasons for its—it's not availability. I think it's partly the—perhaps it is, I don't know, tradition or whatever, proprietary concerns. I've had some—I've had conversations with some of these people before, with Mr. Braegelmann. And we're—were this to be released to us, we do not have the staff to handle it. So maybe it's—it's both sides. We—we were the—might be the channels to make it publicly available if we have the facilities to handle it.

Conversely, I think there is some reluctance in some agencies to reveal how much translating goes on, because of the copyright implications; let's face it. Whether we can get around that sometime or not, I don't know.

Mr. WALGREN. They would then be sort of purloining something they shouldn't reproduce; is that the idea?

Mr. BUDINGTON. I suppose—I don't want to get anybody in trouble on this, least of all, them or myself. But these are translations made from journals, some of which are properly from companies—countries which are signatories to the copyright union.

They are translated as single items translated for research purposes and to some extent I think that's quite fair use.

The question then is the release, how far you release that, before you may have questions raised. They prefer not to have the questions raised.

Mr. WALGREN. Do you other gentlemen feel that that's a substantial restraint on what's happening in this area?

Mr. SEALS. I have no comment.

Mr. WALGREN. Is the Japanese situation a little bit tougher on copyright than other countries?

Mr. BUDINGTON. I don't think there's probably any difference there. There has not been as much translating going on in Japanese. Russian has been the target language of—I mean, the source language, over the years. But Japanese is now outstripping it. We are getting more Japanese translations now than we are Russian.

Mr. WALGREN. Out of curiosity, what was the reason given for the Science Foundation reduction in your funding in 1972? Was that a policy decision that somehow or other this area could be self-supporting?

Mr. BUDINGTON. I—I wouldn't want from memory, or certainly from a civilian point of view, to interpret it. But my understanding was that that the—the policy was that subsidizing of ongoing operations in contrast to one-shot project operations was the distinction. Ongoing operations, they couldn't—would not longer support; that they would have to become self-supporting. The implication there being that if they couldn't be self-supporting, they must not be worth very much.

Mr. WALGREN. Sort of a relative restrictive view of the Science Foundation's charter, or mandate. It would strike me—would it not be true that this is an area where self-sufficiency in funding is—maybe self-defeating, as a general proposition?

Mr. BUDINGTON. It certainly has been very self—been very limiting. When the funds were available, we were able to promote and publicize; we had exhibits at all the major professional society meetings; we had news stories in the professional journals. The number of translations contributed to us was twice what it is now; and the number of requests and use of translations was twice what it is now, because we were able to bring the message to the people who needed it.

Mr. WALGREN. Isn't that interesting?

That's a very important comment, because you would expect the reverse to be true. If this information explosion is really real, and I'm sure it is, then you ought to be four times the size in 1984 that you were in 1972 and, instead, you are half the size.

I wanted to ask a little bit further, or at least see if there are any other suggestions on what this information policy ought to be. Both Mr. Gibson and Mr. Seals have stressed the need in one instance for a strong coordinated plan on the one hand; and Mr. Seals for an actual policy. In your testimony you—you've certainly touched on what—what ought to be in that. But, Mr. Seals, when we come down to it, you say a national policy ought to be adopted to encourage the U.S. information community to foster international cooperation. I gather your international cooperation is focused on the nonprofit computer network, the international computer network, with an attempt to develop standards and uniform characteristics, so that it could be accessed internationally; is that——

Mr. SEALS. That is certainly the focus for the American Chemical Society, but that is not the only interest we have with respect to a government policy. We think it's important that the Government send a clear message to other nations that the U.S. Government supports the free and open flow of public scientific and technical information across national boundaries.

Such a message would be important in trying to build cooperation with other nations. There is a certain fear in Europe and in Japan that the United States might take some measures to cut off the flow of public information. As I pointed out in my testimony, a very high percentage of the documents that we cover come from those countries. So, there is a tremendous fear in that respect. A message from the Government would be helpful.

Another aspect of policy in general, is that the Government state a clear desire to promote cooperation with other countries and not simply to compete.

One of the major problems in information is the cost. These high costs derive, in large part, from duplication of effort. Some duplication of effort is useful; some redundancy is useful; but a lot of it is not useful. We need to work together with other countries to reduce the amount of duplication.

Mr. **Walgren**. Are we at sort of a crossroads of where on the one hand there's the thrust that we want to limit access to U.S. information on a national security basis, and essentially cutting us off from cooperatively developed transfer of information or access to information? Choosing between those two roads to the degree that we choose to cut ourselves off, if we want to have any access to other nations' information, it would have to be by very specific, positive efforts; but to the degree that we go down the cooperative road, we could probably rely on less specific efforts and still have access to what might be necessary?

Is that at all a——

Mr. **Gibson**. I feel that we do not want to go down the primrose path of restricting. We have more to gain by the cooperative approach, than we do restricting the amount that's going out. But we have a significant amount of information now that is going one way, and very little coming back.

I think that is perhaps what my colleague is alluding to, that it—we should have a policy to encourage a much stronger approach to a two-way flow of this information. As has been said practically by all of the speakers this morning, one of the major barriers to this two-way flow is the difference in approach and availability of the language barrier. Until we, in this country, have the same governmental approach to the strong push in Japanese language training, I think we are going to be at a disadvantage. I think that could be a major cornerstone of a governmental program.

Mr. **Walgren**. Mr. Seals?

Mr. **Seals**. I would like to underscore what my colleague has just said. We see in the American Chemical Society very few advantages, if any, in cutting ourselves off, and tremendous disadvantages.

The problem that we face really in the United States is increasing the awareness within our scientific and technical community of what is available from outside the United States. The community has been too parochial in its use of information. We need to increase awareness of what's available outside. We need to break down barriers that already exist. We do not need to establish new barriers to free flow of information.

We will lose a lot more than we would gain by cutting ourselves off. One must remember that a very high percentage of the useful scientific and technical information comes from outside the United States. If we cut ourselves off we will not prevent other nations from getting access to our public literature. That is not possible, because they already have this high awareness in their countries. They have a high demand in their countries. They recognize the value of information and they will get the information by one means or another.

If we start building barriers then we will hurt no one but our own community.

Mr. **Walgren**. Are there any international sources of really broad significance in this area? I'm not sensitive enough to the issue. Especially to know whether witnesses have raised that in any way. When you talk about standards; uniformity, and the interest in free international exchange. Do we look to any presently existing international organization to help us solve this problem?

Mr. **Seals**. Well, surely there are many internationally recognized standard institutes for a variety of problems that exist in the information community, character sets, for example; international telecommunications protocols; bibliographic information, the presentation and recording of bibliographic information; there are many standards.

However, they have not gone to the extent of having uniform presentations of data bases on-line, and uniform command languages, so that if a user learns how to search one system, he knows how to search many systems. Or if he knows how to search one data base, he knows how to search many data bases. Of course, within single systems there are standards, but there are so many systems around. There's a—insufficient standardization among those systems.

Mr. **Gibson**. I think we have the major problem of Konji versus our own alphabet, too, that's almost an insurmountable task as far as unification is concerned.

But if I could go back just a little. I think we have to understand that the Japanese approach information in an entirely different way than we do. We have long tended to rely on indexing and abstracting services in the Western world. The Japanese have not. There is no history in the Japanese culture of this type of an approach to processing information. They have very little long-term experience in all abstracting and indexing. The main body of researchers in the information area are handicapped because their main language is only Japanese, not English. So if we are talking about a universal, we have, again, this language problem that we absolutely must overcome.

Mr. **Walgren**. Well, are there any other thoughts that the witnesses would like to raise?

I want to express, on behalf of the other Members of the Committee, our appreciation of your contributions to this record. We appreciate your being available to us, and being the resource that you are; so on behalf of the Committee, thank you very much.

That concludes these 2 days of hearings on this subject. I'd like to say that the Committee is indebted to all the witnesses who came before us and contributed to this record. I hope that it will lend to the sensitivity of the Congress and be reflected in some specific efforts that we might be able to make. So with that, thank you very much.

[Whereupon, at 12:25 p.m., the subcommittee adjourned.]

APPENDIX

Additional Statements Submitted for the Record

UNIVERSITY OF WISCONSIN–MADISON

COLLEGE OF ENGINEERING

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May 7, 1984

Ms. Carol Pompliano
Committee on Science and Technology
2319 Rayburn House Office Building
Washington, DC 20515

Dear Ms. Pompliano:

I appreciate your invitation to submit a statement to the Committee on Science and Technology of the United States Congress in relation to the recent hearings on Japanese science and technology. I should like to focus on two pressing needs: to survey the Japanese technical literature and determine which Japanese journals are of major importance; to train scientists and engineers who are competent in technical Japanese.

In the early 1970's I surveyed a sample of academic scientists and engineers as to the Japanese journals they considered most important for their research. The vast majority cited very few Japanese journals and indicated that their principal Japanese sources were in English. At the same time I asked a sample of academic scientists and engineers in Japan what were the holdings of their university libraries. The number of Japanese journals mentioned in that survey was far greater and the number published in English far less than I found in the survey of American scientists and engineers. However, in the early 1970's it was difficult to arouse any great interest in the American technical community concerning this significant disparity.

Some American scientists in the survey were aware of the significant body of Japanese technical information not available in English, but they indicated that they monitored those journals by means of the English abstracts that accompanied the articles. The problem with this arrangement is that these English abstracts do not necessarily correspond exactly with the Japanese abstracts. If the journal does not require an exact translation of the Japanese abstracts, then a Japanese scientist whose ability to write in English is not equal to his ability to read technical English may well choose to write a simpler English version with less detailed information. Thus, the presence of the English abstract is no assurance that the American researcher is gaining information equivalent to that gained by a Japanese researcher in his reading of the abstracts. Moreover, some Japanese journals do not furnish English abstracts.

I would recommend, therefore, that the Committee on Science and Technology authorize a thorough survey of Japanese journals in science and technology to determine their relative importance as judged by the Japanese technical community. Such a survey should consider the holdings in the libraries at major Japanese universities, research and testing laboratories, agricultural stations, and significant corporations. Having established what journals are most important, the survey should also classify the journals in terms of the disciplines they cover and the degree to which the English abstracts provided by the journals correspond to the information covered by the Japanese abstracts.

I would also recommend that this survey should determine the most important handbooks and dictionary-encyclopedias used by Japanese scientists and engineers in their disciplines and practice. When the Japanese decide to develop a handbook or dictionary-encyclopedia, they thoroughly study the corresponding reference works developed in all major industrial countries. Thus, with a Japanese handbook or dictionary-encyclopedia, you gain access to well established and up-to-date technical knowledge compiled from many sources.

These handbooks, of course, will be of no use to American scientists and engineers who have no ability to comprehend technical Japanese. But for those who make the effort to master technical Japanese, these sources will prove invaluable both in their language study and in the pursuit of their discipline. How many American scientists and engineers will make that heroic effort? That will depend on how much support and opportunity we offer to university students to develop that skill.

In 1974 I co-authored with Professor R. Byron Bird (Chemical Engineering Department, University of Wisconsin-Madison) and Professor Nobuo Inoue (Mechanical Engineering Department, Science University of Tokyo) the textbook COMPREHENDING TECHNICAL JAPANESE. The book consists of 25 chapters. Each chapter introduces 20 kanji and gives vocabulary and readings that use those kanji.

We chose those kanji on the basis of frequency counts of the kanji that appear in Japanese high school texts in physics, chemistry, and biology. We found that we could teach the student the most frequent 300 kanji in each of these major sciences by covering 500 kanji in our textbook. That is because the most frequent kanji overlap. It turns out roughly that the most frequent 300 in physics include 200 of the most frequent 300 in chemistry, and the most frequent 300 in physics and in chemistry include 200 of the 300 most frequent in biology. In structuring the textbook we began with the kanji that are most frequent in physics, then went to chemistry, and ended with biology, thus following the order in which the fundamental laws and concepts in science take shape.

Despite the availability of COMPREHENDING TECHNICAL JAPANESE since 1974,college and university courses in technical Japanese have yet to develop. The book requires that the student first complete a year of traditional Japanese language study, and relatively few colleges and universities have Japanese language programs. Moreover, even those that do offer Japanese language fail to reach students in the sciences and engineering and, even if they did, their Japanese language staff is trained in language and literature and not in the sciences. Until recently I taught technical Japanese only to a scattered number of students on an individual basis under independent study. This past year for the first time I offered technical Japanese as a formal two semester course that covers COMPREHENDING TECHNICAL JAPANESE and supplementary readings in the student's own field.

This change did not result from any great surge of student interest.

It came because the College of Engineering has proposed a five year study program that includes a minor in Japanese studies. The students in this program will study at a Japanese university and intern in Japanese industry at the close of their undergraduate career. The University of Wisconsin Foundation recently launched a campaign to raise funds to offer scholarships in this program.

However, whatever the success of this intensive program and others underway at other engineering schools, I doubt whether such programs can meet the need our nation has for scientists and engineers who can read technical Japanese. I believe that every company engaged in serious, innovative research and development should have one scientist or engineer trained in technical Japanese. Without somebody thus trained it is necessary to send Japanese technical articles out to a translation service,and this strikes me as a waste of both time and money.

The core of substantial information in a technical article comes primarily in the discussion of the results. Thus, translating the entire article includes material of secondary importance. Of course, when a researcher cannot talk directly with the translator, there is no other recourse. Moreover, the full translation can be sent to researchers at the multiple laboratories connected with a large enterprise. Nonetheless I think it would be far more efficient and effective to have a technical Japanese translator available for direct consultation with R&D personnel.

How then can we train these technical translators? I would recommend that the Committee on Science and Technology establish an NSF scholarship program to enable students in the sciences and engineering to attend an intensive summer course in technical Japanese. Scholarship awards would include travel, tuition, and living expenses, and these awards would be based on a student's demonstrated ability in science or engineering and successful completion of a first year Japanese course. The summer program would also include lectures and readings in Japanese civilization and culture and in the history of modern Japan.

Several years ago I sent a letter proposing this idea to the United States-Japan Cooperation Program at the National Science Foundation, and it circulated to various other offices. I received one positive response from an official in science education programs who said that, though he saw the need for such a venture, no funds were available in his office. I trust that this letter will bring both a positive response and the necessary funds to launch such a nationwide summer intensive program in technical Japanese.

Sincerely yours,

Edward E. Daub

Edward E. Daub
Professor
College of Engineering
University of Wisconsin-Madison

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WRITTEN REMARKS BY HERMAN BARON
ON
THE HEARINGS ON MARCH 6-7, 1984
HELD BY
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

March 12, 1984

Thank you for the opportunity to place these remarks in the Official Record of the Hearings. I attended the two days of hearings on the availability of Japanese scientific and technical information in the United States, and believe that a great deal of valuable information was uncovered. There are a number of points which I would like to address.

The first point concerns the question of Japanese language requirements. I firmly believe that the Federal Government should help underwrite the cost of educating high school and college students who are planning to study not only the Japanese language, but also Chinese and Korean as well. In the next five to ten years, we will find that China, Korea, Hong Kong and Singapore will be making substantial progress in various technological areas. These advances will be conceived and carried forward in languages which very few American engineers and business people have been trained to read or write. Therefore, a national program, similar to that which took place in reaction to the Russian Sputnik in the 1950's, is necessary today to help prepare future researchers to acquire information about Asian technology. Existing programs at MIT, NYU and North Carolina State provide excellent examples for this type of study.

Second, I believe that the Subcommittee should encourage NTIS to undertake high level negotiations with JICST (The Japan Information Center of Science and Technology). These discussions should center on NTIS and JICST working out an arrangement whereby U.S. researchers could access that portion of the JICST database which contains information in the Japanese language about Japanese technical journals. This would involve a vast amount of effort to translate the information into English, but perhaps this could be a mutual effort between NTIS, JICST, and academic study centers in the U.S.

I am involved with a new U.S.-based information provider, the Japan Technical Information Service (JTIS), which will be abstracting and indexing over 400 Japanese technical journals, both in print form and electronically. This new service has selected the most important journals in a number of critical areas: microcomputers, robotics, CAD/CAM, land vehicles, fine ceramics, biotechnology, and other cutting-edge technologies. This is the largest and most comprehensive service to abstract Japanese technical literature, but it is only a first step in terms of the vast number of journals published in Japan. Let me encourage the Subcommittee to include consideration of a national effort to procure English-language information from Japan.

BOSTON COLLEGE
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DEPARTMENT OF PHYSICS
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June 1, 1984

Carol Pompliano
Committee on Science and Technology
2319 Rayburn House Office Building
Washington, DC 20515

Dear Ms. Pompliano,

A recent issue of Nature noted the proposal in the Committee on Science and Technology to fund translations of Japanese scientific and technical articles. Over the past twenty five years I have had numerous opportunities to become familiar with the work of Japanese colleagues to the extent that this work appeared in English language periodicals. I have been very highly impressed with the work of many Japanese scientists, as well as the lack of recognition of this work in the American scientific community. I recently returned from a visit to Japan which served to reinforce these favorable impressions of the quality of Japanese science. I am therefore supportive of the Committee's efforts to make this work more readily available to American scientists and engineers through the medium of translation.

I wish to point out, however, that one of the best, if not the best, oriental science collections, in the original languages, is at the Air Force Geophysics Laboratory Research Library, Hanscom Field, MA. The coverage of this collection is extensive and in-depth. For many years Mr. Norman Ng, responsible for the collection, provided abstracts in English of the periodicals, as well as translations of requested articles. As a then employee of the Laboratory I made use of both these abstracts and translations. It seems to me that needless duplication of effort could be avoided if the existing abstracts and translations could be collected and made more widely available as part of the overall effort. Furthermore I believe it would be helpful if the existence of this valuable national resource would be more widely publicized in the American scientific community.

I hope these comments will be helpful to your efforts at providing greater awareness of the many contributions of Japanese science.

Yours truly,

Sam Silverman

Sam Silverman
Senior Research Physicist
Editor, History of
Geophysics Newsletter

1022
|
1027 no corrections

1028 Mr. POLSKY. Well, I was sworn to secrecy,

1029 when some American high-tech companies told me about their monitoring activities in Japan

1030 which are quite legal, by the way. I didn't have

1031 any discussions about intelligence collecting that was not from open sources. But it's

1032 quite true in a lot of international matters that those

1033 people who are most successful don't usually

1034 advertise the fact. I was quite encouraged by some companys' programs to collect intelligence from Japan's science and technology sector.

1035 A couple of the companies I talked to are very

1036 major electronic or high-tech firms in this country.

1037 The kind of intellectual and philosphical underpinnings by

1038 which they collect and assess scientific and technical data from Japan

is quite impressive.

1039 (delete entire line)

1040 (delete entire line)

1041 American companies sometimes do not reward thinkers. I mean, you sit there with a pile of documents and you
1042 have read them, and you spend a couple hours looking

1043 out the window and just thinking about what

1044 you've read. Well, that hasn't been the American way as

1045 (no changes)

1046 that I talked to about collecting and assessing scientific developments in Japan do exactly that.

1047 These American executives go to Japan, they visit, they have friends
1048 there, they sometimes employ Japanese consultants.
1049 These Americans do a lot of thinking, not only about present,
1050 immediate competitive threats and trends
1051 in Japan, but over the long term. This has
1052 been quite an accomplishment for a few companies in our private sector.
But, overall intelligence-
1053 (no changes)
1054 I think, personally, has gotten too reliant on technology.
1055 We rely too much on satellites and
1056 electronic intelligence, rather than unique human brain power. Really, the
1057 best kind of intelligence collection and analysis comes from just this business
of
1058 thinking about things after you've read about them. And, of course,
1059 (no changes)
1060 background as an historian and journalist.
1061 Some of the companies I talked to
1062 have been approached about testifying in front of
1063 (no changes)
1064 individuals. There seemed, in some cases, a certain reluctance because
of
1065 concerns that the Japanese are very quick to start talking
1066 about American spying. The American companies don't want to get
1067 exposed to such charges as a result of testifying here.
1068 I think that the companies who do such research on Japan would be
willing to share with one
1069 another. In one particular case, an
1070 (no changes)
1071 expense of having documents translated.

1072 He said that every time he's had an urge to talk to

1073 (no changes)

1074 about Japanese science and technology--just get together and think

1075 things out--his company lawyers say no.

1076 You can hardly talk to or have lunch

1077 with anybody anymore under some of the rules of

1078 (no changes)

1079 (no changes)

1080 (delete entire line)

1081
|
1092 no corrections

1093 Mr. POLSKY. If the meaning of your question

1094 is that American companies would share information on Japan as long as they are not letting any

1095 competitor know about the product that's coming

1096 out next spring--I think the answer is yes. But the nature of

1097 (no changes)

1098 science and also the law, as well as marketing.

1099 How could you create a fraemwork either with the

1100 antitrust division, or any other regulatory or

1101 (no changes)

1102 of a basic scientific research and information about Japan's research? I think they would be

1103 willing to do it. But there would have to be some

1104 real thought given to how such sharing could occur in a fashion

1105
|
1121 no corrections

1122
|
1134 no corrections

1135 made an effort to talk to the American Electronics Association just prior
to my testimony

1136 here. I was not successful in reaching them. I think their

1137 project in Japan is just starting, as I understand it.

1138
|
1146 no corrections

1147
| no corrections
1171

1172 | 1178 no corrections

1179 barrier.

1180 I hark back to my own experience as a teacher of

1181 (no changes)

1182 during the war. And then we had plenty of

1183 motivation; there was a demand; and we trained

1184 hundreds of G.I.s to serve as military translators.

1185 Many of these people after the war went on to

1186 | 1190 no corrections

1191 motivated to the difficult task of learning Japanese in the way the first group was. And, I think the

1192 basic problem is motivation.

1193 Now, in the testimony so far,

1194 | 1196 no corrections

1197 translation, a search, and indexing efforts in Japan, or here.
1198 (no changes)
1199 (no changes)
1200 benefit U.S. industry as a whole. Here is where
1201 motivation may be lacking. It's the individual company
1202 trading with Japan that has a specific reason for wanting to get
1203 that information. Trade associations want to protect
1204 their industry against competition; use this as their
1205 defensive reaction to perceived competition and competitive
1206 threat.
1207 But motivation is required particularly for the broader objective of
getting scientific and
1208 technical information from Japan that is available to the general U.S.
1209 business world; to the scientific and technical world; the
1210 academic world.
1211 Basically, it's the realization there's
1212 (no changes)
1213 This is where our government can help by
1214 providing the seed money as someone has mentioned. Certainly,
1215 there should be a deepening of awareness that American knowledge of the
Japanese language is a resource that cannot

1216
|
1221 no corrections

1222
|
1241 no corrections

1242 Mr. TSUKAHIRA. I have no way of knowing in detail

1243 what is the extent and the scope of the effort made by our

1244 defense agencies. But I could hazard a guess,

1245 (no changes)

1246 motivation there to know what is being written in Japanese about various scientific and technical matters.

1247 The problem is that such information isn't being

1248
|
1253 no corrections

1253 Mr. TSUKAHIRA. I certainly can say this

1254
|
1256 no corrections

1258 I speak a couple of them badly

1259 is a terribly difficult process. And probably

1260 Japanese is, as my colleague would say, one of

1261 the most difficult. And another colleague in my company, Cathay Counsellors Group, Inc., Mr. Alfred Harding, who

1262 is a Chinese language linguist and also a retired Foregn Services Officer, would say the same. You

1263 have to have a very powerful motivation and incentive to learn foreign language.

1264 Of course, it existed during the period that Dr. Tsukahira refers to in

1265 (no changes)

1266 intelligence officers right on every island in the Pacific.

1267 Then there was a crushing national

1268 crisis, which provided a lot of very dedicated

1269 Americans that extra motivation to learn Japanese. And today, you get into

1270 these subjects of trade and economics--and it's pretty hard

1271 to relate a business crisis in the Ohio Valley to the need

1272 for learning more Japanese.

1273 I don't personally have the answer to this

1274 (no changes)

1275 through the tremendous drudgery and repetition of learning

1276 a language like Japanese.

1277 (no changes)

1278 East, and the way I managed without much language ability was I had a lot of local friends

1279 in the different countries I was in. And these local friendships,

1280 plus the translations that were available to me, made me a knowledgeable foreign correspondent. It's a tremendously time-consuming

1282 effort, in any case, whether you know the language or not.

1283 Perhaps

1284 | 1286 no corrections

1287 (delete entire line)

1288 | 1296 no corrections

1297
|
1310 no corrections

1311 I think perhaps the first obstacle to be overcome is

1312 American impatience and unwillingness to operate and plan on a

1313 long-term basis internationally or even, for that

1314 (no changes)

1315 (no changes)

1316 and carrots to convince American companies they

1317 should be systematic and patient in the long-term

1318 collection of the scientific and technical data from countries like Japan, then maybe you can find

1319 acquisition of language expertise might not be so difficult.

1320
|
no corrections

1324

Testimony of James R. Bartholomew, March 6, 1984: Corrections

1361 "civilian" not "surveying"

1380 delete "worldwide"

1403 "late" not "light"

1406 "private" not "pirate"

1407 delete "the" and "produced"

1414 delete "a"

1422 "attention" not "tension"

1441 "in" not "of"

1450 commas after "nearly" and "seen"

1469 "in every" not "nearly"

1473 "resource" not "research"

2114 "out" not "ought" delete "to"